260-1.4
AMERICAN STEEL DREDGE COMPANY, INC
code 700

PARTS & INSTRUCTION MANUAL

for

Wayne Crane

Model 40

SURPLUS

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CRANE SHOVEL, POWER UNIT, REVOLVING, TRUCK MOUNTED, PNEUMATIC TIRED, TWO-ENGINE DRIVE, GASOLINE ENGINE DRIVEN, 10 TON, ½ CU. YD., CLASS 1-1 SIZE 10 TA, 6 x 6 TRUCK.

CONTRACT NO. DA-11-184-ENG-7909
DATE—2 JUNE 1951
PROCESSED FOR EXPORT

MFR.	PART NO.	DESCRIPTION	QUAN.
700	026 40A	MANUAL	1 EA

SEC-DATE
C. G. D. ENG. SECT., COLUMBUS, OHIO

American Steel Dredge Company Inc.
WAYNE CRANE DIVISION
FORT WAYNE, INDIANA

REV.—10-52

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1/2 YARD PULL SHOVEL DIPPER
SHOVEL ASSEMBLY
SHOVEL DIPPER
SHOVEL SHIPPER SHAFT ASSEMBLY
SHOVEL BOOM POINT ASSEMBLY
ELECTRIC DIPPER TRIP ASSEMBLY
PILE DRIVER ASSEMBLY

INSTRUCTIONS FOR ORDERING WAYNE CRANE PARTS

It is our strict policy to give immediate attention to all orders for Wayne Crane replacement parts. We try to ship the same day an order is received.

We ask that you help us by being absolutely sure to give the following information on every order:

1. Serial number of the machine on which parts are used.
2. The part number shown in this book.
3. Description of part exactly as shown in this book.
4. Name and address to which parts are to be sent.

Please check this book carefully before placing your order. Part numbers and descriptions are given on the reverse side of the illustration of each assembly. The list of illustrations is shown in the front of the book.

When ordering by telegraph, for convenience and economy, use telegraphic code shown on next page.

ALWAYS GIVE SERIAL NUMBER OF MACHINE ON WHICH PARTS ARE TO BE USED

When ordering parts always give post office address, town, county and state where parts are to be sent. Also state whether parts are to be shipped by freight, express or parcel post.

Improvements on the WAYNE CRANE will be made from time to time and these improvements may affect the part which you order. If, in our opinion, the cost of the improved part, plus any additional parts necessary for its use will justify the extra expense to the owner, we will send the improved part unless the machine owner specifies that the original part is to be furnished.

INSTRUCTIONS FOR ORDERING WAYNE CRANE PARTS
(continued)

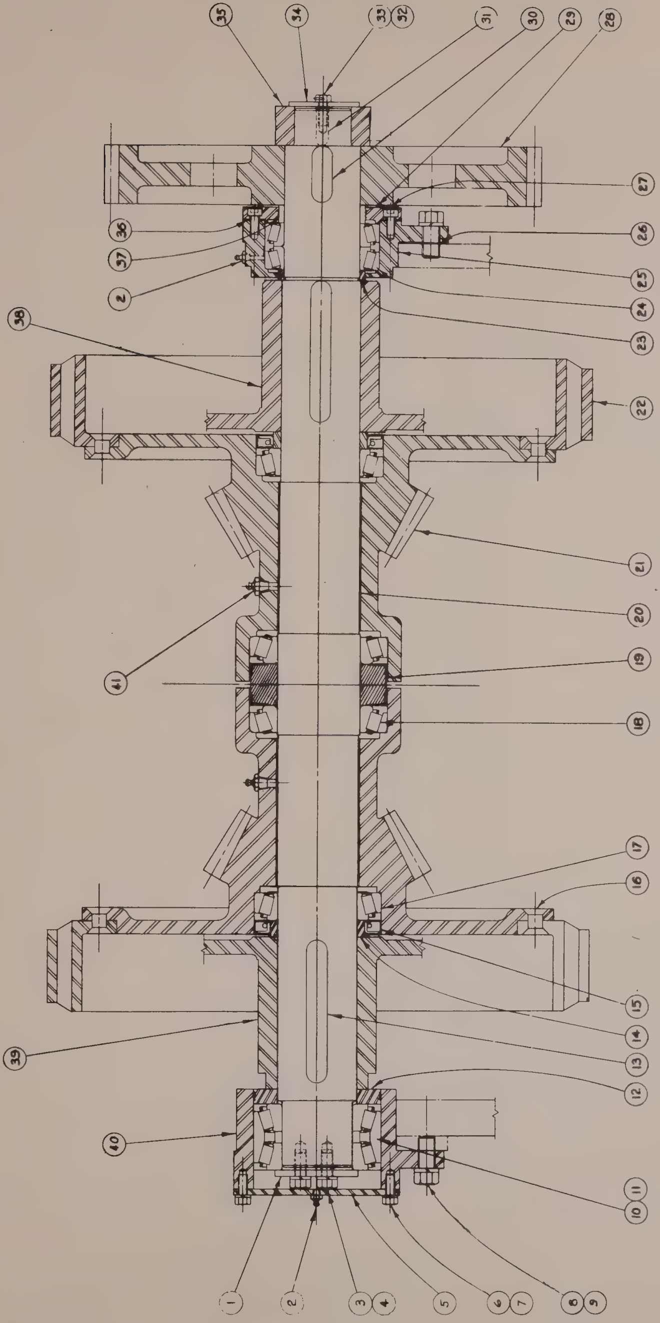
TELEGRAPHIC CODE

GICOY - Ship to me (us) by express
GIBNY - Ship by express to
GICIV - Ship to me (us) by mail
GIZRI - Ship by mail to
GIZBU - Ship to me (us) by freight
GIXNO - Ship by freight to
GIZTA - Advise when and how you shipped my (our) order
GIXSA - Cancel my (our) parts order
GIZMY - Add to my (our) parts order
GIXPY - Duplicate shipment of my (our) order
GIXRA - Quote prices F.O.B. factory on
GIXIN - Parts ordered are for machine serial number______
GIXET - You may add the parts as suggested
GIXTV - Ship by air express
GIXTA - Ship by air freight

HORIZONTAL SWING SHAFT

(Use With Hydraulic Boom Hoist)

(See Reverse Side for Part Numbers and Description)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When Ordering Parts Always Give Serial Number of Machine

WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

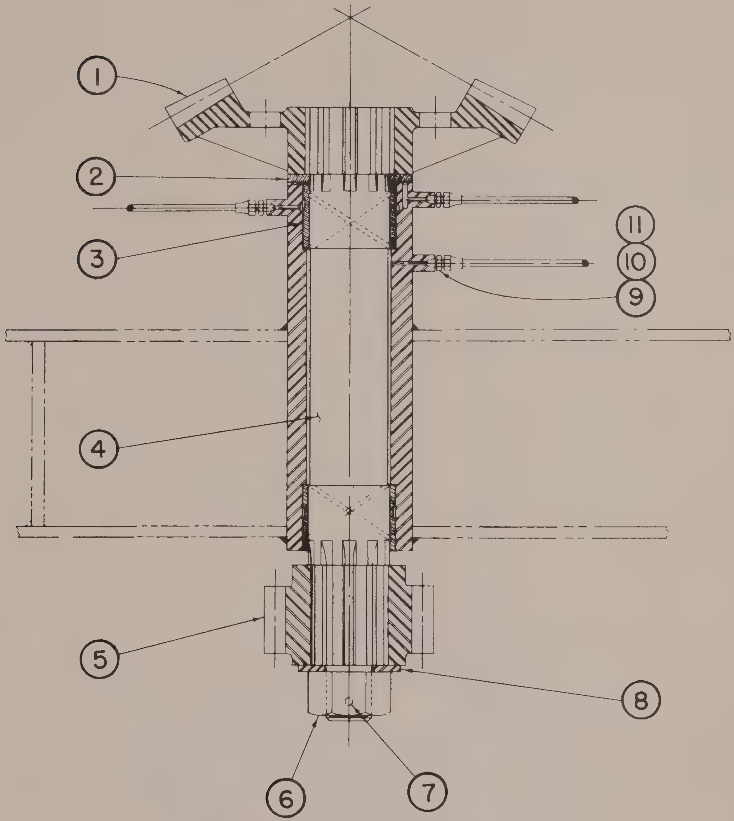
Horizontal Swing Shaft Assembly - Complete CR-2552DA
(Used with Hydraulic Boom Hoist)
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2417A	1	L.H. End Plate
2		2	Alemite Fitting 1/8" N.P.T.
3		3	1/2"-20 N.F. Hex Hd. Cap Scr. 1" Lg.
4		3	1/2" Std. Lockwasher
5	66-2408B	1	L.H. Pillow Block Cover
6		6	3/8"-24 N.F. Hex Hd. Cap Scr. 3/4" Lg.
7		6	3/8" Std. Lockwasher
8		8	5/8"-18 N.F. Hex Hd. Cap Scr. 1 1/2" Lg.
9		8	5/8" Std. Lockwasher
*10	ASD-1501	1	Bearing
*11		1	Spacer
12	66-2411A	1	Spacer
13		2	7/8" x 7/8" Key 6" Lg.
14	66-2412A	2	Spacer
15	ASD-1602	2	Oil Seal
16		24	Csk. Head Rivet 5/8" x 1 5/8"
17	ASD-1502	2	Bearing
18	ASD-1503	2	Bearing
19	66-2415B	1	Center Ring
20	66-2418C	1	Horizontal Swing Shaft
21	66-2045D	2	Bevel Swing Pinion
22	17-005	2	Clutch Flange
23	66-2413A	1	Spacer
24	ASD-1504	2	Bearing
25	66-2409C	1	R.H. Pillow Block
26	66-2422A	1	Shim
27		6	3/8"-24 N.F. Soc. Hd. Cap Scr. 3/4" Lg.
28	66-2044C	1	Spur Gear
29	66-2410B	1	R.H. Pillow Block Cover
30		1	7/8" x 7/8" Key Rd. End 2 7/16" Lg.
31		1	1/2" x 1/2" Key Rd. End 1 9/16" Lg.
32		2	3/8"-16 N.C. Hex Hd. Cap Scr. 1" Lg.
33		1	Lock Wire
34	66-2302A	1	Sprocket (Cover Plate)
35	CR-2673A	1	Spacer
36	66-2421A	1	Shim
37	66-2414A	1	Spacer
38	66-2517C-2	1	20" Clutch Assembly L.H.
39	66-2517C-1	1	20" Clutch Assembly R.H.
40	66-2407C	1	L.H. Pillow Block
41		2	Alemite Fitting 1/4" N.P.T.

*Furnished only as matched set.

Vertical Swing Shaft

(See Reverse Side for Part Numbers and Description)



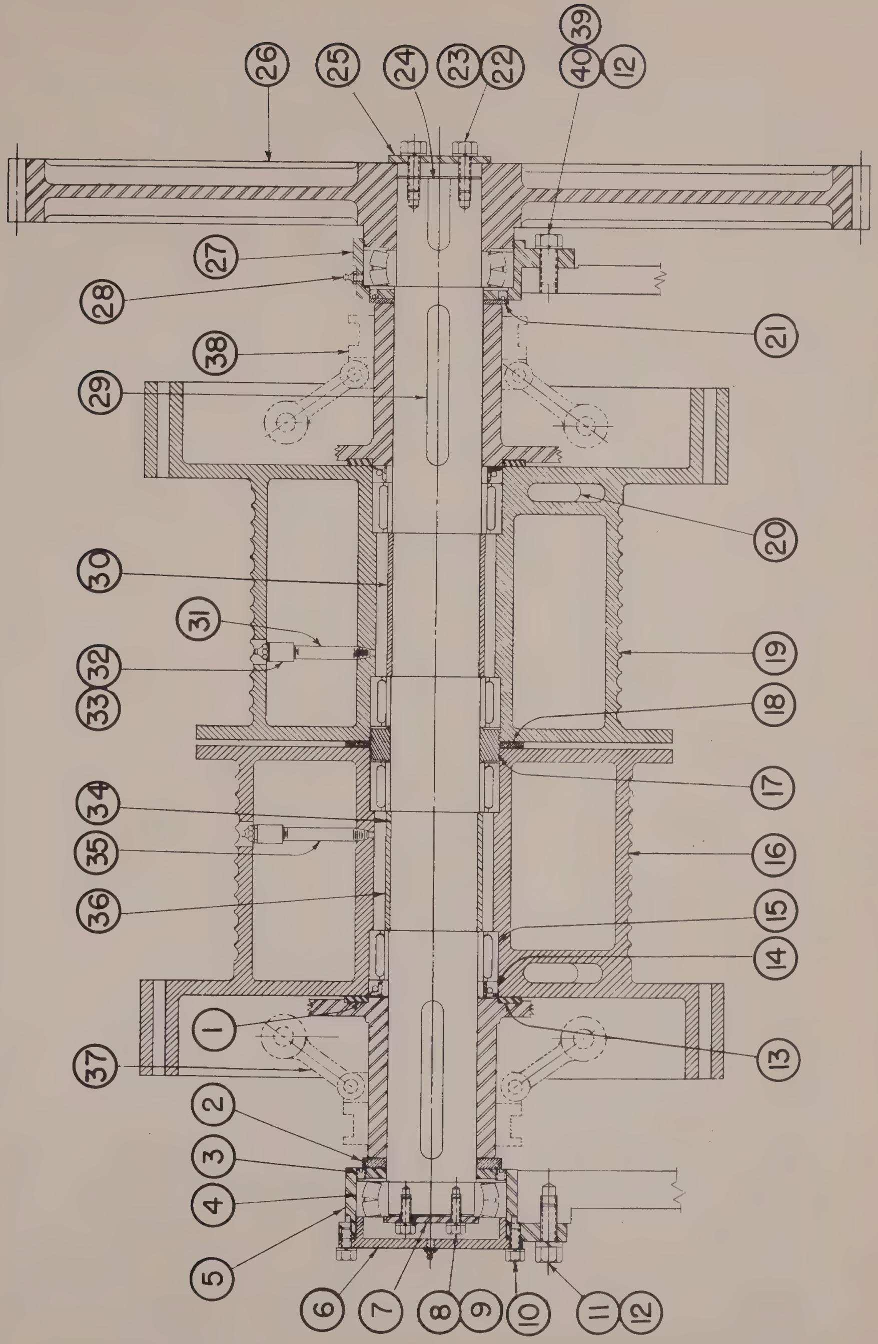
When Ordering Parts Always Give Serial Number of Machine

Vertical Swing Shaft Assembly Complete #66-2585D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2041C	1	Gear
2	66-2420A	1	Washer
3	66-2419A	2	Sleeve Bearing
4	66-2042C	1	Shaft
5	17-044-1	1	Pinion
6		1	2"-4 1/2 N.C. Hex Nut
7		1	1/4" Cotter Pin x 4" Lg.
8	17-045	1	Washer
9		6	1/8" N.P.T. Male Connector 1/4" O.D. Tube
10		3	1/4" O.D. Tubing x 30" Lg.
11		3	1/8" N.P.T. #1610 Alemite Fitting

Drum Shaft

(See Reverse Side for Part Numbers and Description)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When Ordering Parts Always give Serial Number of Machine

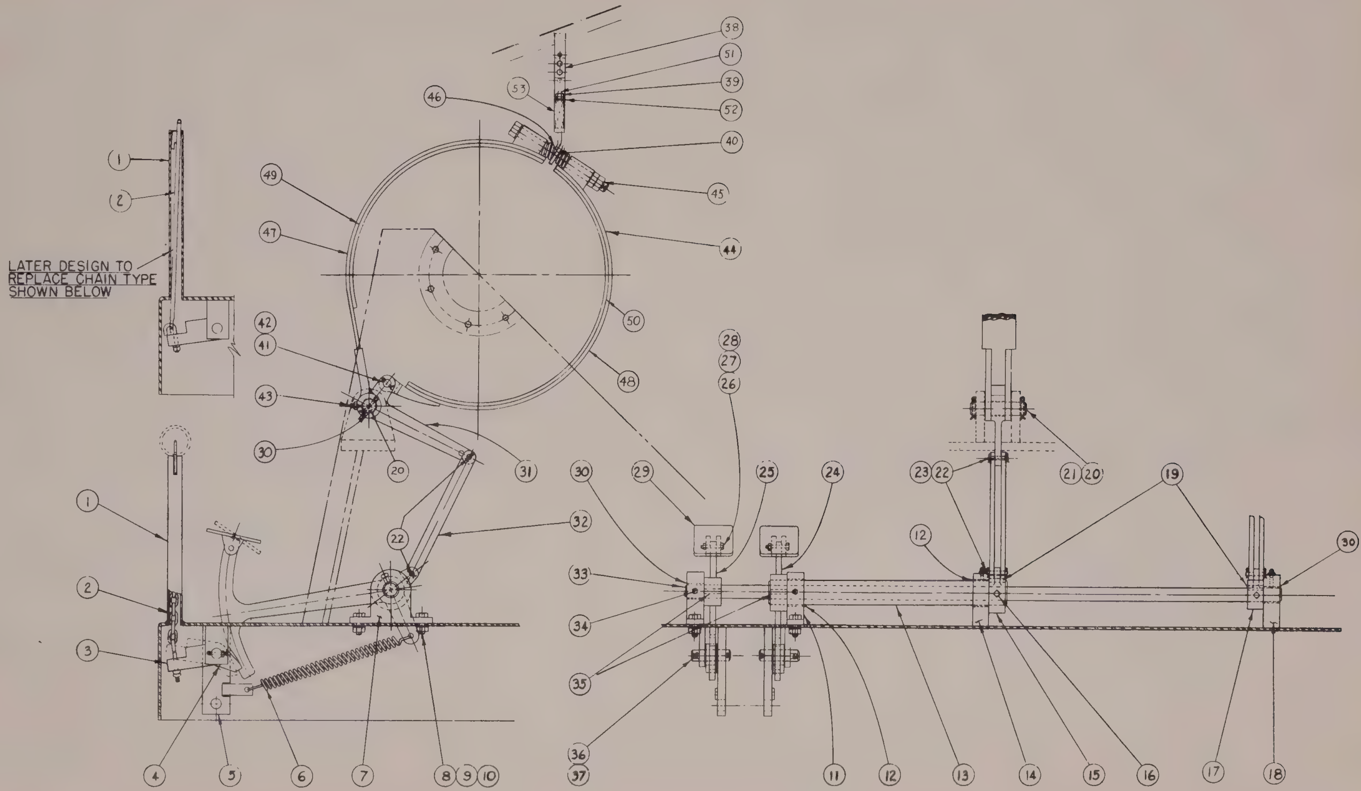
Drum Shaft Assembly Complete #66-2551D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	17-406	2	Thrust Washer 7" O.D. x 5.127" I.D.
2	17-414-F	1	Washer 5 1/2" O.D. x 3 17/32" I.D.
3		4	1/4" Socket Hd. Pipe Plug
4	ASD-1510	2	Bearings #DE-22217
5	66-2515B	1	L.H. Pillow Block
6	17-030	1	L.H. Pillow Block Cover
7	17-335	1	Bearing Retainer Plt.
8		2	3/8"-16 N.C. Hex Hd. Cap Scr. 1" Lg.
9		8	3/8" Std. Lock Washer
10		6	3/8"-24 N.F. Hex. Hd. Cap Scr. 7/8" Lg.
11		4	5/8"-18 N.F. Hex. Hd. Cap Scr. 1 3/4" Lg.
12		8	5/8" Std. Lock Washer
13	17-032	2	Oil Seal Retainer
14	ASD-1606	2	Oil Seal
15	ASD-1511	4	Bearings #E9718
16	17-004	1	L.H. Drum
17	17-007	1	Center Ring
18	17-404	1	Washer
19	17-003	1	R.H. Drum
20	17-006	2	Wedge
21	17-414G	1	Washer
22		2	1/2" Std. Lock Washer
23		2	1/2"-20 N.F. Hex. Hd. Cap Scr. 1 1/2" Lg.
24		1	7/8" x 7/8" Key 2 7/8" Lg.
25	66-2416A	1	R.H. Cover Plt.
26	66-2423C	1	Gear
27	66-2514B	1	R.H. Pillow Block
28		2	1/8" Alemite
29		2	7/8" x 7/8" Key 6 1/8" Lg.
30	17-033B	1	Spacer
31		1	1/4" Nipple Blk. 3" Lg.
32		2	1/4" Std. Pipe Coupling
33		2	1/4" Alemite #1627
34	17-009	1	Shaft
35		1	1/4" Nipple Blk. 3 3/4" Lg.
36	17-033A	1	Spacer
37	66-2517C-3	1	L.H. Clutch Assembly
38	66-2517C-4	1	R.H. Clutch Assembly
39		4	5/8"-18 N.F. Hex. Hd. Cap Scr. x 2 1/2" Lg.
40		4	5/8"-18 N.F. Hex. Nut

NOTE: On cranes Serial Nos. 350 to 359 incl. (except 356) Item 37 is 17-013-D; Item 38 is 17-013-C.

DRUM BRAKE ASSEMBLY

(See Reverse Side for Part Numbers and Description)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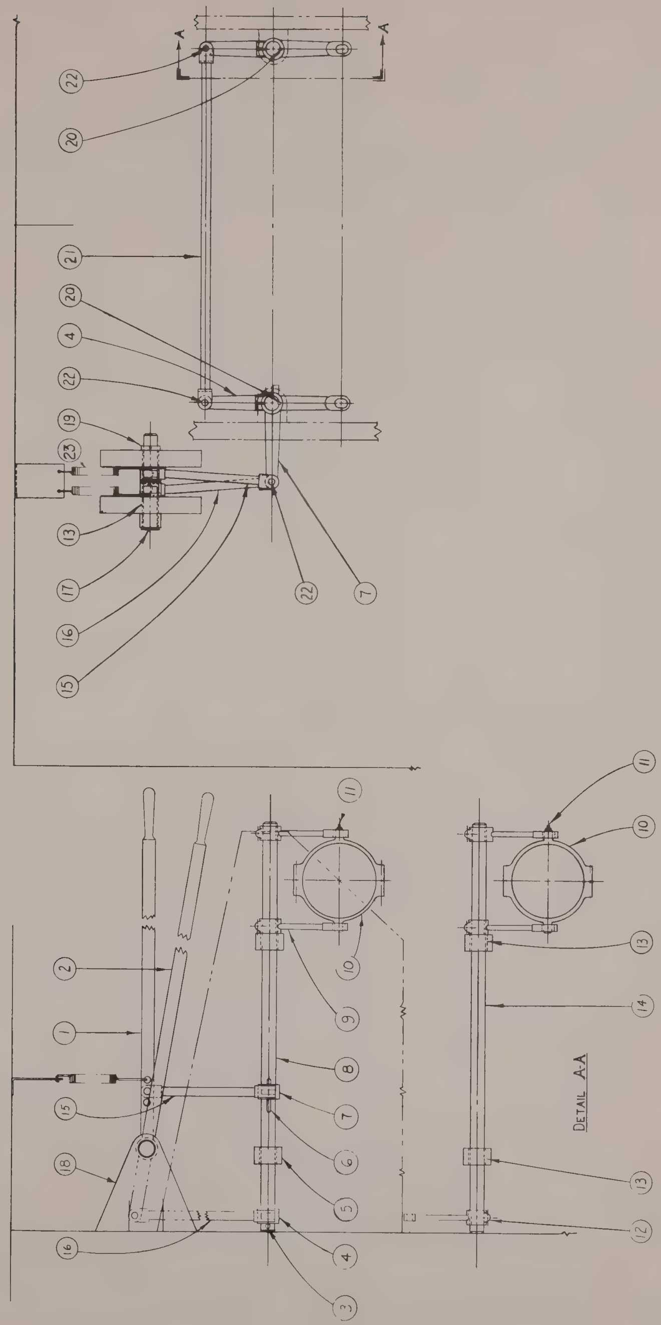
Drum Brake Assembly Complete #CR-2590DB
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
*1	66-2099A	2	Chain Tube
2	66-2579AA	2	Pawl Lifter Assembly
3	66-2580A	2	Pawl
*4	66-2091A	2	Bracket
*5	66-2090A	2	Bracket
6	L-74	2	Spring
7	66-2204A	1	Brake Pedal Bracket
8		4	1/2"-13 N.C. Hex Hd. Bolt 1 1/2" Lg.
9		4	1/2"-13 N.C. Hex Hd. Nut
10		4	1/2" Std. Lockwasher
11	66-2139A	1	Brake Pedal Bracket
12	66-2192A	2	Bushing
13	66-2133A	1	Shaft
*14	66-2167A	1	Brake Pedal Bracket
15	66-2246B	1	Sub Lever
16		4	1/2"-13 N.C. Sq. Hd. Set Screw (Cup Pt.) 3/4" Lg.
17	66-2221A	1	Sub Lever
*18	66-2147A	1	Brake Pedal Bracket
19		2	Key 5/16" x 5/16" x 1 1/4"
20	ASD-1007-1	2	Pin 1 1/4" Dia. 5 1/4" Lg.
21		4	1/4" Dia. Cotter Pin 2" Lg.
22	ASD-1003-3	4	Pin 1/2" Dia. 2" Lg.
23		8	3/16" Dia. Cotter Pin 1" Lg.
24	66-2210C	1	L.H. Drum Brake Pedal
25	66-2211C	1	R.H. Drum Brake Pedal
26		2	3/8"-16 N.C. Hex Hd. Bolt 1 1/2" Lg.
27		2	3/8"-16 N.C. Hex Hd. Nut
28		2	3/8" Lockwasher
29	66-2534A	2	Pedal Pad
30	ASD-1029	4	Bushing 1 3/8" O.D. x 1 1/4" I.D. x 1 1/4" Lg.
31	66-2143B	2	Bellcrank
32	66-2140A	4	Drum Brake Toggle
33	66-2132A	1	Shaft
34		4	1/8" N.P.T. Alemite Fitting #1610
35		2	Key 5/16" x 5/16" x 1 1/2" Lg.
36	ASD-1017-1	2	Pin 1" Dia. 3 1/8" Lg.
37		2	7/32" Dia. Cotter Pin 1 1/2" Lg.
**38	66-2633A	2	Brake Band Support
39		4	3/8"-16 N.C. Hex Jam Nut
40	66-2631A	1	Spacer Bar
41		4	7/32" Dia. Cotter Pin 1 1/4" Lg.
42	ASD-1005-1	4	Pin 3/4" Dia. 2 3/4" Lg.
43		2	1/8" N.P.T. Alemite No. 1610
44	66-2461D	2	Brake Band Assembly
***45		2	7/8"-9 N.C. Sq. Hd. Bolt and Hex Nut (2)
46	2050A	4	Spring
47	66-2461D-2	2	Upper Band (Lined)
48	66-2461D-1	2	Lower Band (Lined)
***49	66-2461D-4	2	1/4 x 3" Brake Lining and #10-8 - 1/2" Rivets
50	66-2461D-3	2	1/4 x 3" Brake Lining and #10-8 - 1/2" Rivets
51	CR-2911A	2	3/8"-16 N.C. Eye Bolt x 5" Lg.
52		2	3/8" Plain Washer
53	66-2632A	2	Lifter Spring

* Welded to Revolving Base
** Welded to Cab
*** Included With Item 44 When Furnished Complete

DRUM CLUTCH CONTROL

See Reverse Side for Part Numbers and Description.



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DETAIL A-A

Drum Clutch Control Assembly - Complete #66-2588D

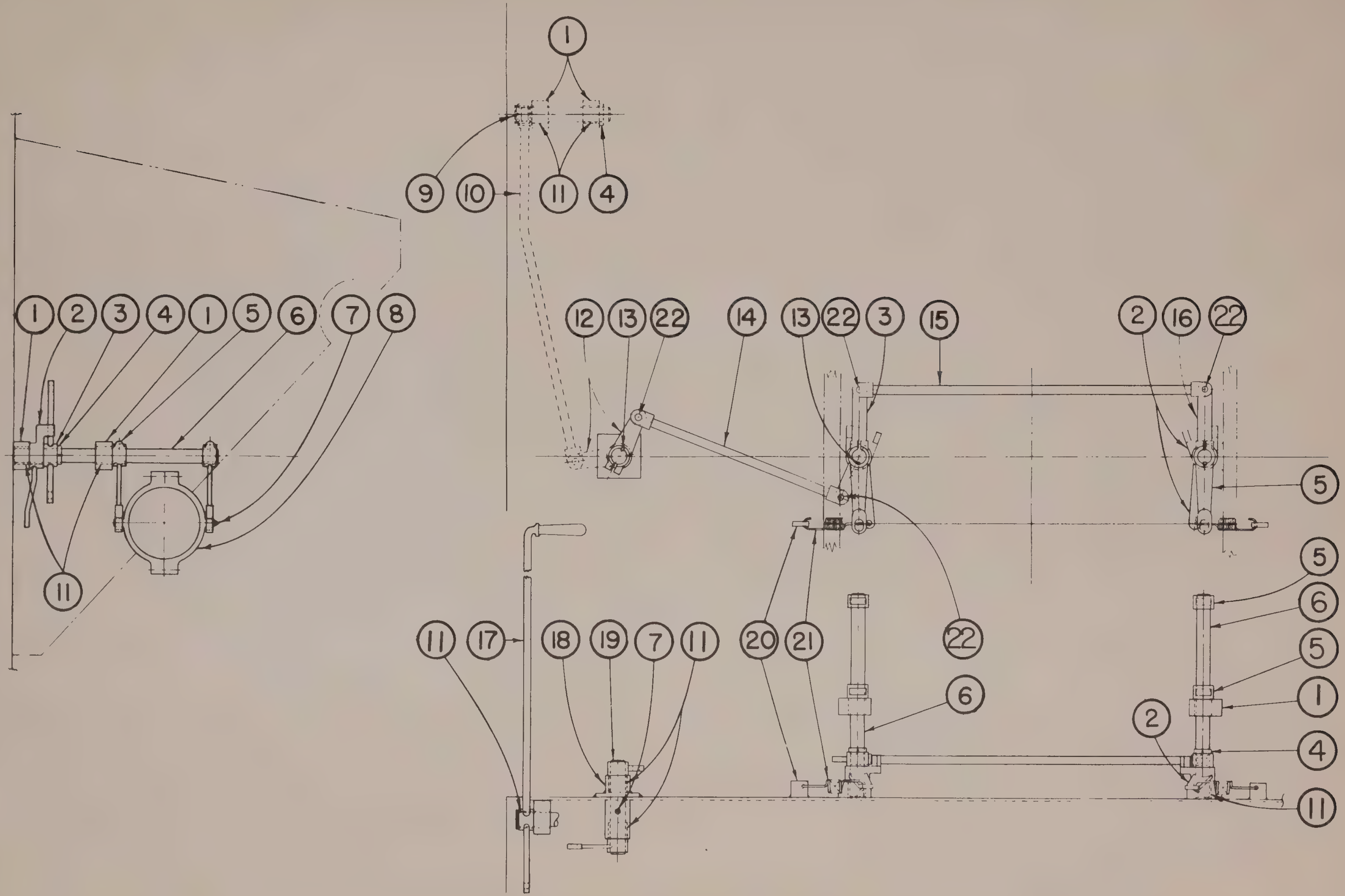
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2012B	1	L.H. Drum Control Lever
2	66-2013B	1	R.H. Drum Control Lever
3		1	Cotter Key 3/16" x 2 1/2"
4	66-2019A	1	Bell Crank
*5	66-2195A	4	Support Bracket
6		1	Key 5/16" Sq. x 3" Lg. Rd. End.
7	66-2324A	1	Sub Lever 7"
8	66-2460B	1	Shaft - L.H. Clutch Control
**9	66-2015A	4	Shifter Arm
**10	66-2014B	2	Shifter Collar
11		2	Alemite #1610
12	66-2010A	1	Sub Lever 6"
13	ASD-1029	8	1 1/4" x 1 3/8" x 1 1/4" Bushing C.G.B. 1029-C
14	66-2459B	1	Shaft - R.H. Clutch Control
15	66-2048B-6	1	Connecting Rod
16	66-2048B-2	1	Connecting Rod
17	66-2458A	1	Shaft - Drum Control Lever
18	66-2441A	2	Support Bracket
19		1	1 1/4" Std. Shaft Collar
20		5	Key 5/16" Sq. x 1 1/4" Lg. Rd. End
21	66-2048B-5	1	Connecting Rod
22		6	1/2" Std. Clevis Pin Assembly
23	SK-1461	2	Spring

*Welded to Pedestal
**Includes Clamp Bolts

Swing Clutch Control

(See Reverse Side for Part Numbers and Description)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Swing Clutch Control Assembly Complete #66-2589D
(See Reverse Side for Illustration)
Assembly Consists of:

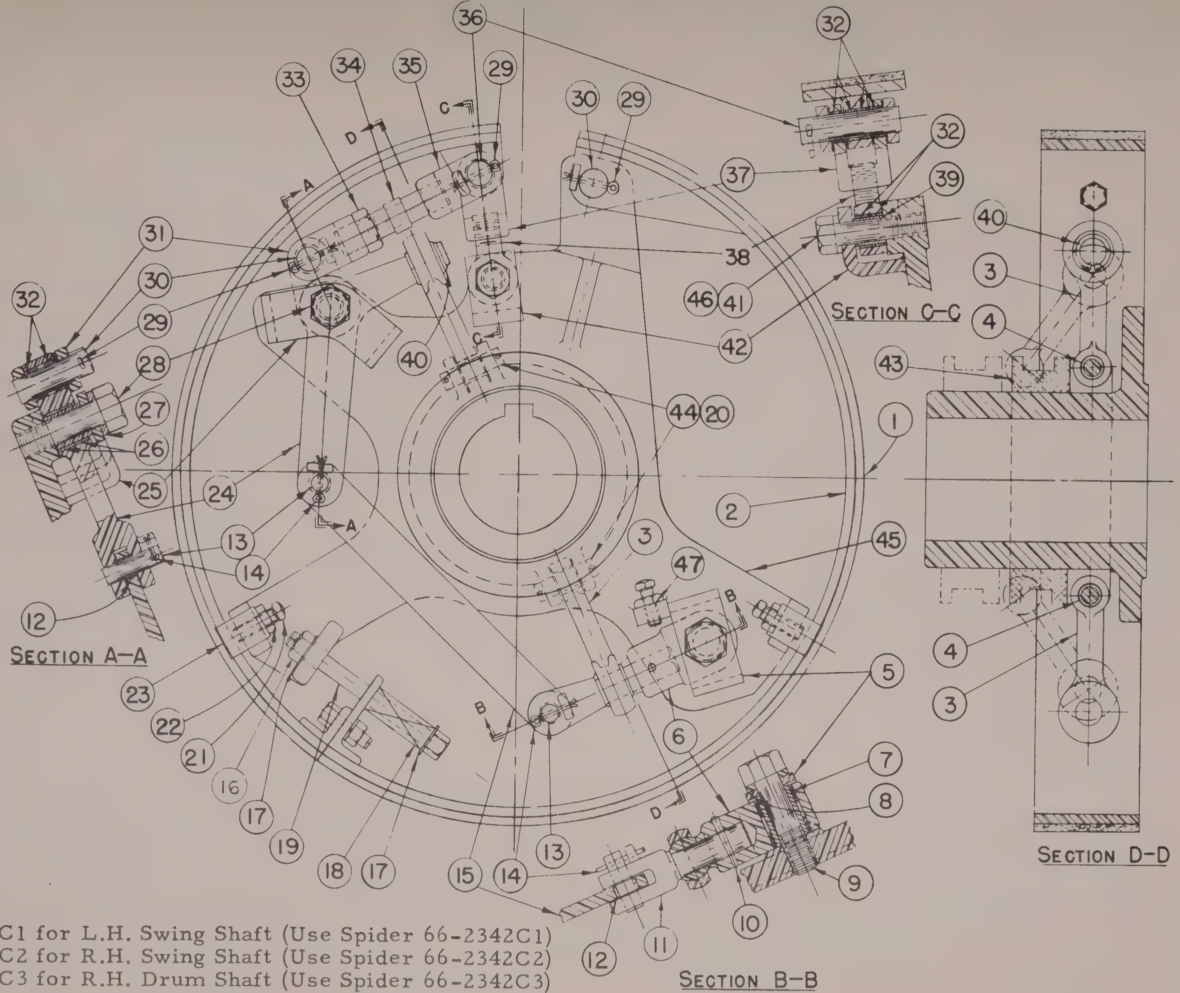
Item	Part No.	Qty.	Name of Part
*1	66-2195A	6	Support Bracket
2	66-2455B	2	Shifter Dog
3	66-2454A	1	Bell Crank
4		3	1 1/4" Dia. Std. Shaft Collar
**5	66-2015A	4	Shifter Arm
6	66-2456A	2	Shaft Clutch Shifter
7		2	Alemite #1610
**8	66-2014B	4	Shifter Collar
9	66-2458A	1	Shaft Swing Con. Lev.
10	66-2577B	1	Connecting Rod
11	ASD-1029	9	1 1/4" x 1 3/8" x 1 1/4" Bushing C.G.B. 1029-C
**12	66-2017A	2	Sub Lever 4"
13		8	Key 5/16" Sq. x 1 1/4" Lg. Rd. End
14	66-2048B4	1	Connecting Rod
15	66-2048B5	1	Connecting Rod
16	66-2018A	1	Sub Lever 6"
17	66-2011BA	1	Swing Control Lev.
*18	66-2470B	1	Bracket Swing Control
19	66-2196A	1	Shaft Swing Control
*20	66-2453A	2	Spring Anchor Brkt.
21	66-2051A	2	Equalizer Spring
22		6	1/2" Std. Clevis Pin (Incl. Cotter)

* Welded to Revolving Base
** Clamp Bolts Included

20 CLUTCH - STYLE #2

See Reverse Side for Part Numbers and Description.

(Use for Serial No. 360 and up)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NOTE:
(66-2517C1 for L.H. Swing Shaft (Use Spider 66-2342C1)
** (66-2517C2 for R.H. Swing Shaft (Use Spider 66-2342C2)
(66-2517C3 for R.H. Drum Shaft (Use Spider 66-2342C3)
(66-2517C4 for L.H. Drum Shaft (Use Spider 66-2342C4)
RIGHT-HAND ASSEMBLY SHOWN

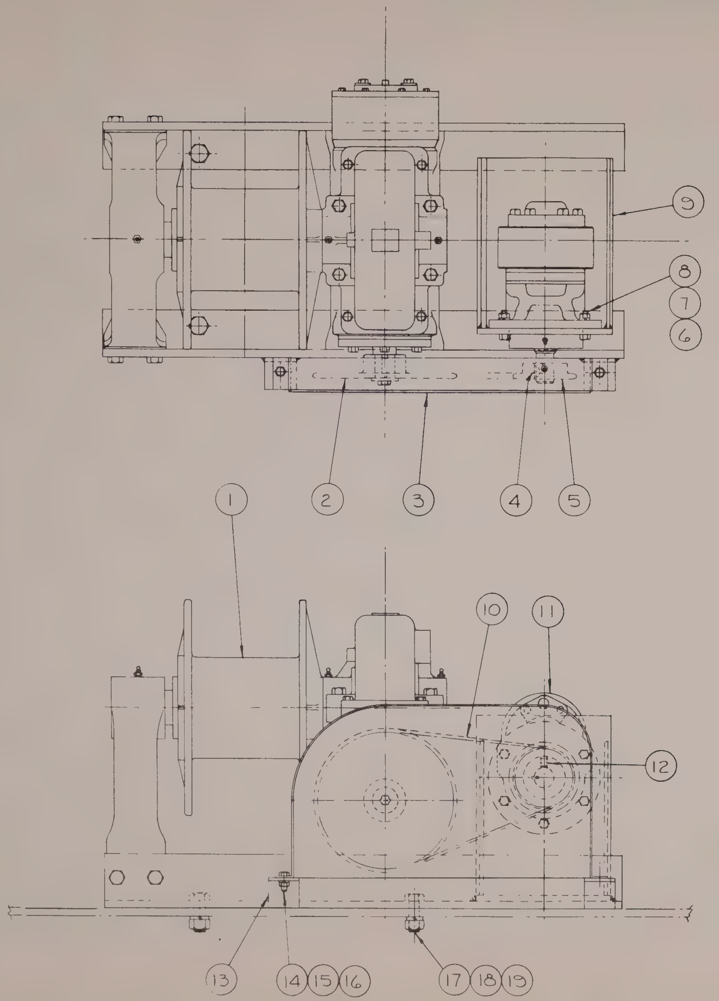
20" Clutch Assembly - Style #2 - Complete #66-2517C
(Use for Serial No. 360 and up)
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2343C	1	Clutch Band Assembly
2	66-2343C-9	1	Lining Incl. Rivets
3	66-2500A	2	Toggle Link
4	66-2510A-4	2	Bushing
*5	66-2362A	1	Dead Lever Bracket
6	66-2349A	1	Dead Lever Rod End
7	66-2365A	1	Sleeve
8		2	3/4" Lockwasher
9		1	3/4"-16 N.F. Hex Hd. Bolt 2 3/4" Lg.
10		1	No. 3 Taper Pin 1 1/2" Lg.
11	66-2348A	1	Dead Lever Rod
12	66-2510A-3	2	Bushing
13	ASD-1014-1	2	Pin 1 3/4" Lg.
14		2	3/16" Dia. Cotter Pin 1 1/4" Lg.
15	66-2508A	1	Connecting Link
16		1	1/2"-13 N.C. Self Locking Nut
17		2	1/2" Flat Washer
18	66-2562A	1	Spring
19		1	1/2"-13 N.C. Hex Hd. Bolt x 5" Lg.
20		5	3/16" Dia. Cotter Pin 1 1/4" Lg.
21		3	3/8"-16 N.C. Sq. Hd. Set Scr. 1 1/4" Lg.
22		3	3/8"-16 N.C. Hex Jam Nut
23	SK-1327-1	2	Keeper
24	66-2347B	1	Live Lever (R.H. Shown)
*25	66-2361B	1	Live Lever Bracket
26	66-2510A-1	4	Bushing
27	66-2364A	1	Sleeve
28		1	3/4"-16 N.F. Hex Hd. Bolt 2 1/2" Lg.
29		3	7/32" Dia. Cotter Pin 1 1/2" Lg.
30	ASD-1016-1	2	Pin 2 5/16" Lg.
31	66-2354A	1	Connecting Link Rod End
32	66-2510A-2	6	Bushing
33		1	3/4"-16 N.F. Hex Jam Nut
34	66-2352A	1	Connecting Link Rod
35	66-2353A	1	Connecting Link Rod End
36	ASD-1016-2	1	Pin 3 1/8" Lg.
37	66-2356A	1	Guide Link Rod End
38	66-2355A	1	Guide Link Rod
39	66-2366A	1	Sleeve
40	5100-75	1	Retaining Ring
41		1	5/8"-18 N.F. Hex Hd. Bolt 2 1/2" Lg.
*42	66-2363A	1	Guide Link Bracket
43	66-2511B	1	Clutch Shifter
44	ASD-1003-1	2	Pin 2 1/8" Lg.
**45	See Note	1	Clutch Spider
46		1	5/8" Lockwasher
*47	66-2624A	1	Stop Block

*Welded to Spider
**See NOTE on Drawing

BOOM HOIST ASSEMBLY - HYDRAULIC

(See Reverse Side for Part Numbers and Description)



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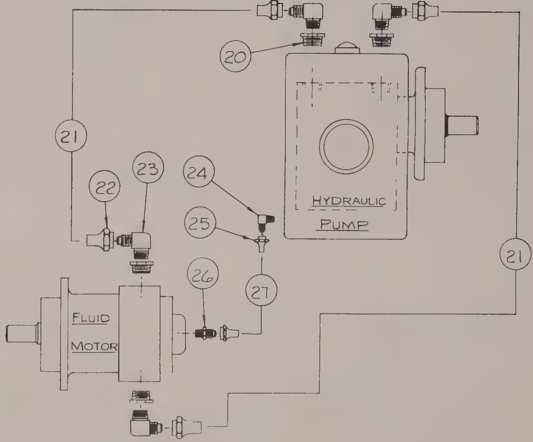

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HYDRAULIC PUMP
FLUID MOTOR

When Ordering Parts Always give Serial Number of Machine

WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

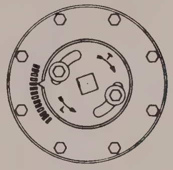
Boom Hoist Assembly - Hydraulic - Complete #CR-2869C
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	CR-2847B	1	Winch Assembly
2	CR-2828B	1	45T Sprocket
3	40-2748A	1	Chain Guard
4		1	Woodruff Key #13
5	CR-2829B	1	19T Sprocket
6		5	5/8"-18 N.F. Hex Hd. Cap Scr. x 1 3/4" Lg.
7		5	5/8"-18 N.F. Hex Nut
8		5	5/8" Lockwasher
9	40-2747A	1	Fluid Motor Mtg. Brkt.
10		1	66 Pitches - 5/8" Pitch Roller Chain
11	75649	1	Fluid Motor - LaPlant-Choate
12		1	3/8"-16 N.C. Soc. Hd. Set Scr. x 7/8" Lg.
13	CR-2868A	2	Chain Guard Support
14		2	3/8"-16 N.C. Hex Hd. Cap Scr. x 1" Lg.
15		2	3/8"-16 N.C. Hex Nut
16		2	3/8" Lockwasher
17		4	3/4"-16 N.F. Hex Hd. Cap Scr. x 2" Lg.
18		4	3/4"-16 N.F. Hex Nut
19		4	3/4" Lockwasher
20		4	1" to 3/4" Pipe Bushing
21	1503-12-L	2	5/8" I.D. Hyd. Hose 8 ft. Lg.
22	411-12	4	Swivel Hose Fitting
23	2024-12-12	4	3/4" Tube to 3/4" N.P.T. - 90° Elbow (Male)
24	2024-4-5	1	5/16" Tube to 1/4" N.P.T. - 90° Elbow (Male)
25	411-5	2	Swivel Hose Fitting
26	2021-4-5	1	5/16" Tube to 1/4" N.P.T. - Male Tube Adapter
27	1503-5-L	1	1/4" I.D. Hyd. Hose 8 ft. Lg.
*28	17-602A	1	1/2" Wire Rope Wedge

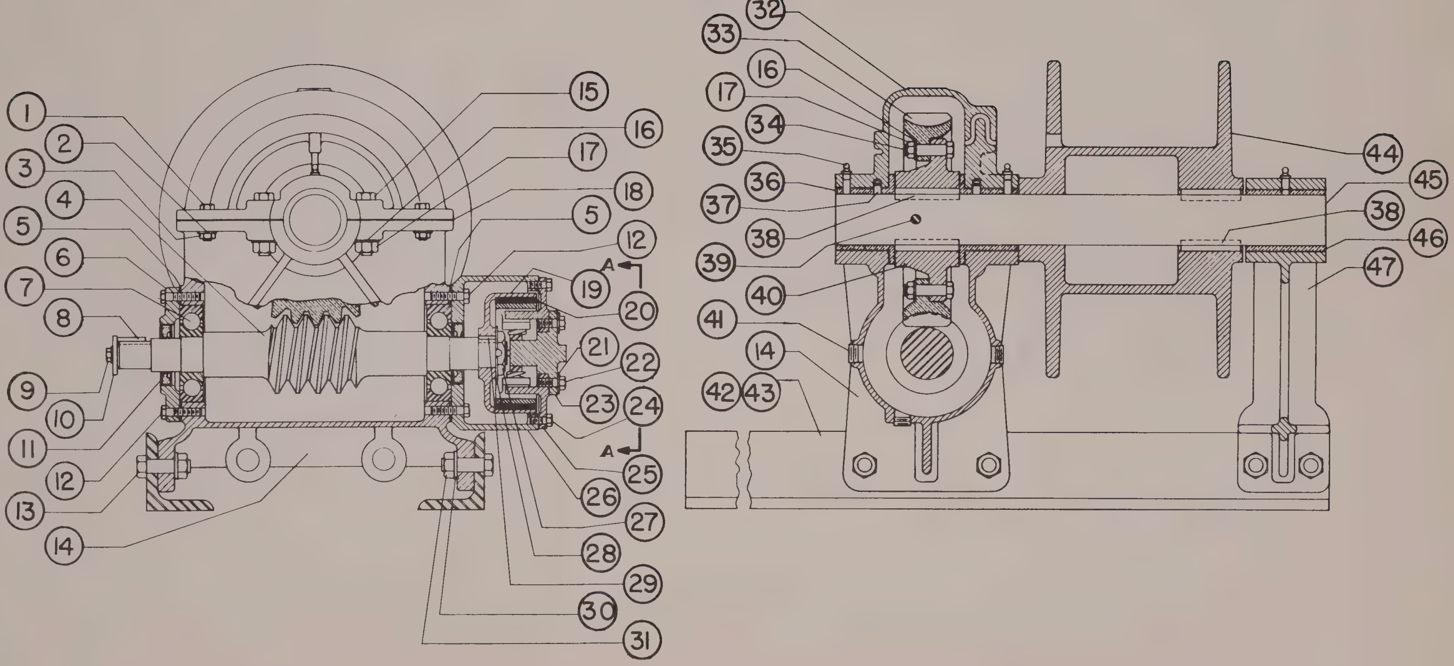
*Not Shown On Illustration

MODEL 19 WINCH ASSEMBLY

See Reverse Side for Part Numbers and Description



VIEW 'A-A'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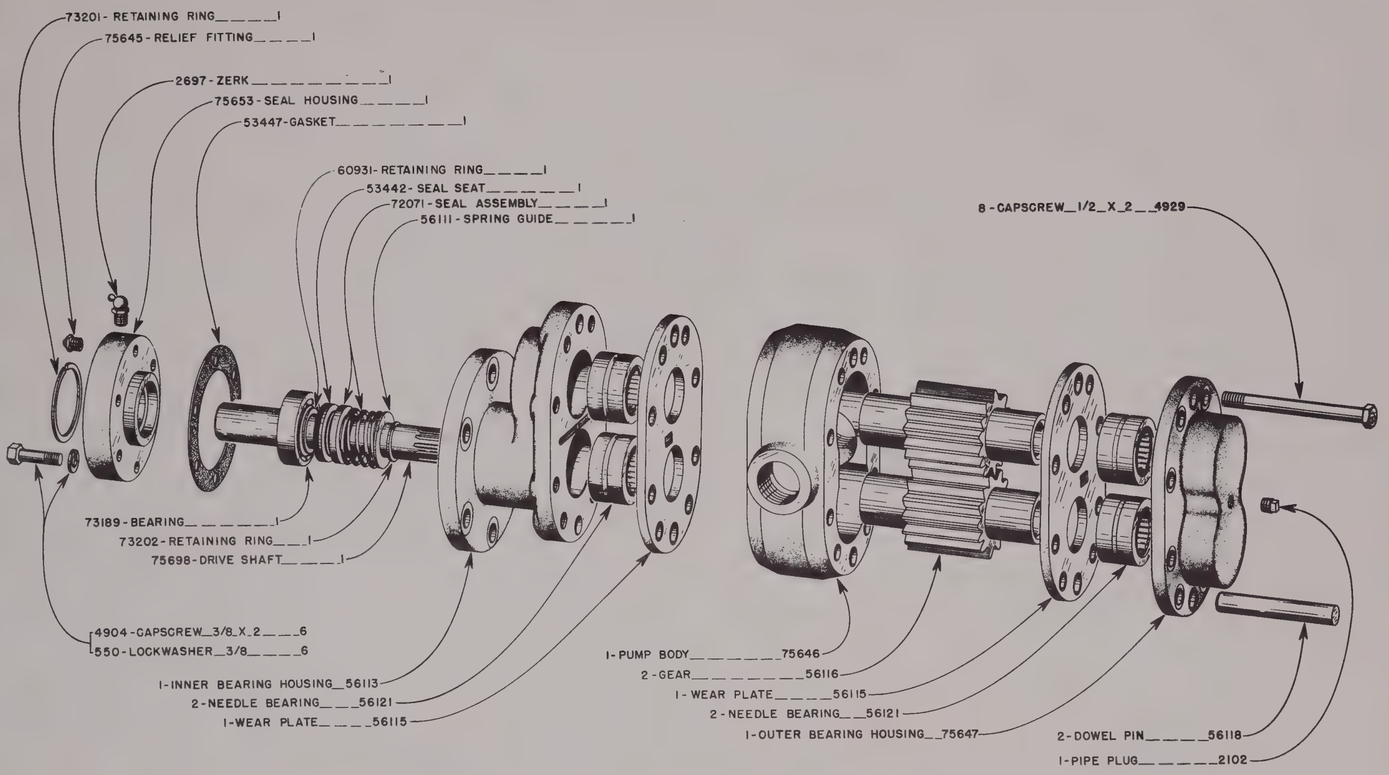
Model 19 Winch Assembly Complete #JA460
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part	Item	Part No.	Qty.	Name of Part
1	20325	4	Cap Screw 3/8"-24 N.F. x 1 1/2" Lg. Hex Hd.	26	20082	1	Housing
2	20526	5	Lock Washer 3/8" SAE Standard	27	20114	1	Nut
3	20271	4	Nut 3/8"-24 N.F. Hex - Light	28	20115	1	Lock Washer
4	20240	1	Worm - L.H.	29	20279	1	Key
5	20117	2	Gasket	30	20558	8	Lock Washer 5/8" SAE Standard
6	20080	1	Cap	31	20295	8	Nut 5/8"-18 N.F. Hex - Light
7	20302	2	Bearing McGill #408N or Equivalent	32	20298	1	Cover
8	20105	1	Key 70-05-06	33	20239	1	Gear - L.H.
9	20278	1	Cap Screw 3/8"-24 N.F. x 1" Long - Hex Hd.	34	21059	8	Cap Screw
10	20092	1	Washer	35	20516	3	Grease Fitting Stewart Warner #1608 or Equivalent
11	20232	2	Grease Retainer				
12	20289	12	Cap Screw 3/8"-16 N.C. x 1 1/2" Lg. Hex Hd.	36	20171	2	Bushing
13	20406	8	Cap Screw 5/8"-18 N.F. x 2" Lg. Hex Hd.	37	20517	2	Dowel Pin
14	20332	1	Housing	38	20182	4	Key
15	20268	4	Cap Screw 1/2"-20 N.F. x 2 1/2" Lg. Hex Hd.	39	20717	1	Pin 3/8" x 5" Type 1 Groov-Pin or Equivalent
16	20518	12	Lock Washer 1/2" SAE Standard	40	20190	1	Carrier
17	20267	12	Nut 1/2"-20 N.F. Hex - Light	41	20286	3	Pipe Plug 1/2"-14 NPT Countersunk Head
18	20181	2	Gasket	42	10716	1	Frame
19	20084	1	Drum	43	10717	1	Frame
20	SA1102	2	Assembly - Brake Shoe	44	10714	1	Drum
21	20617	2	Washer	45	10715	1	Shaft
22	20522	2	Cap Screw 3/8"-16 N.C. x 1" Lg. - Hex Hd.	46	20178	1	Bushing
23	20065	1	Cam - R.H.	47	20330	1	Bracket
24	20280	8	Cap Screw 5/16"-18 N.C. x 3/4" Lg. Hex Hd.	48	21775	2	Drive Screw #2 x 3/16" Lg. - "U" Type
25	20068	1	Cap	49	21184	1	Name Plate

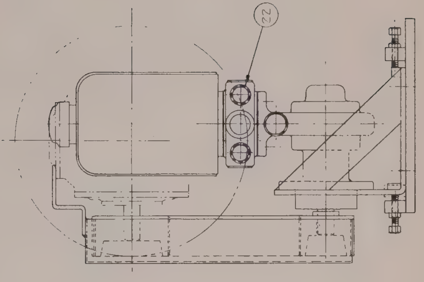

73201- RETAINING RING_____1
75645- RELIEF FITTING____1
2697- ZERK__________1
75653- SEAL HOUSING_____1
53447- GASKET_________1
60931- RETAINING RING____1
53442- SEAL SEAT______1
72071- SEAL ASSEMBLY____1
56111- SPRING GUIDE_____1
8- CAPSCREW_1/2_X_2__4929
73189- BEARING________1
73202- RETAINING RING___1
75698- DRIVE SHAFT_____1
4904- CAPSCREW_3/8_X_2___6
550- LOCKWASHER_3/8____6
1- INNER BEARING HOUSING__56113
2- NEEDLE BEARING____56121
1- WEAR PLATE____56115
1- PUMP BODY________75646
2- GEAR__________56116
1- WEAR PLATE_____56115
2- NEEDLE BEARING___56121
1- OUTER BEARING HOUSING__75647
2- DOWEL PIN______56118
1- PIPE PLUG______2102

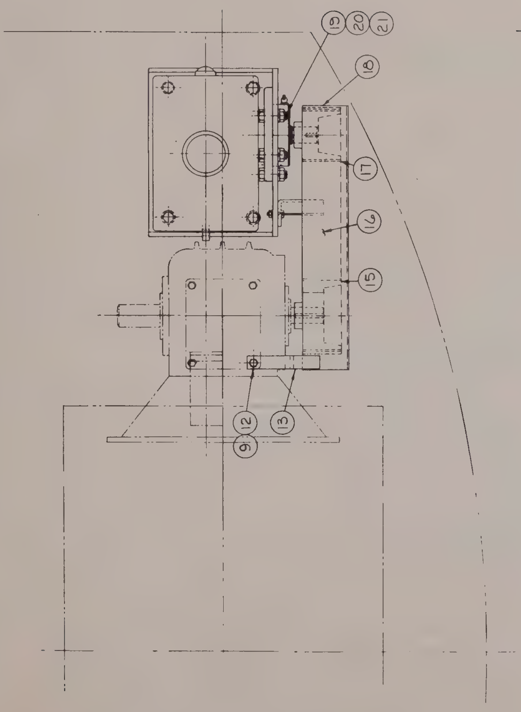
75649 - HYDRAULIC MOTOR, MODEL HM-25

P. 3114

HYDRAULIC POWER ASSEMBLY

(See Reverse Side for Part Numbers and Description)

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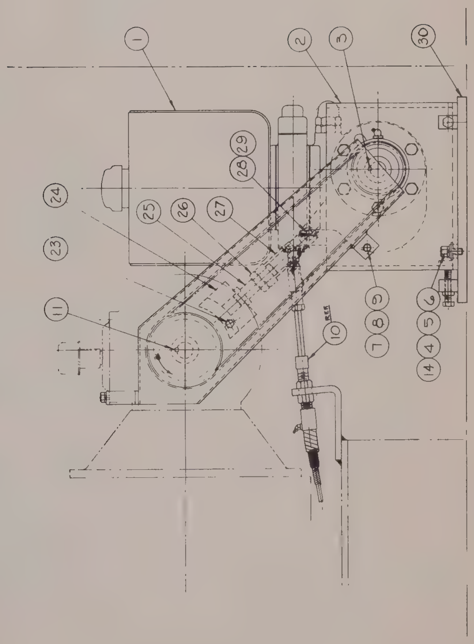
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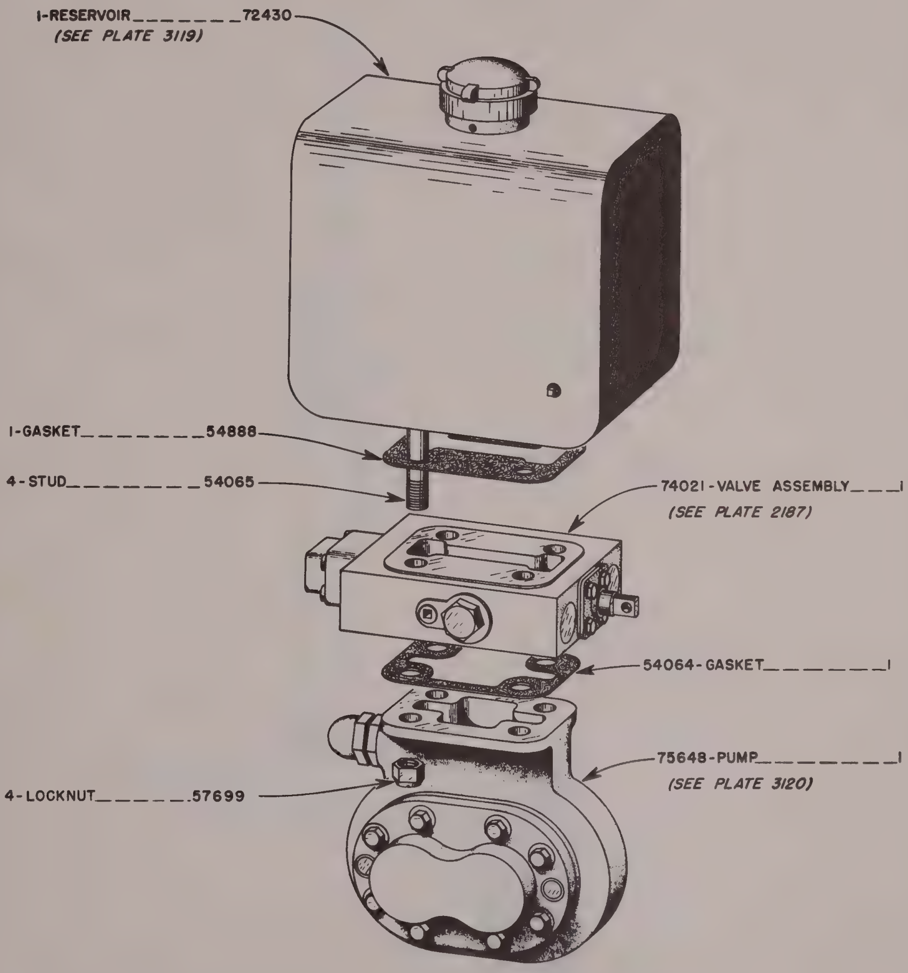
When Ordering Parts Always Give Serial Number of Machine

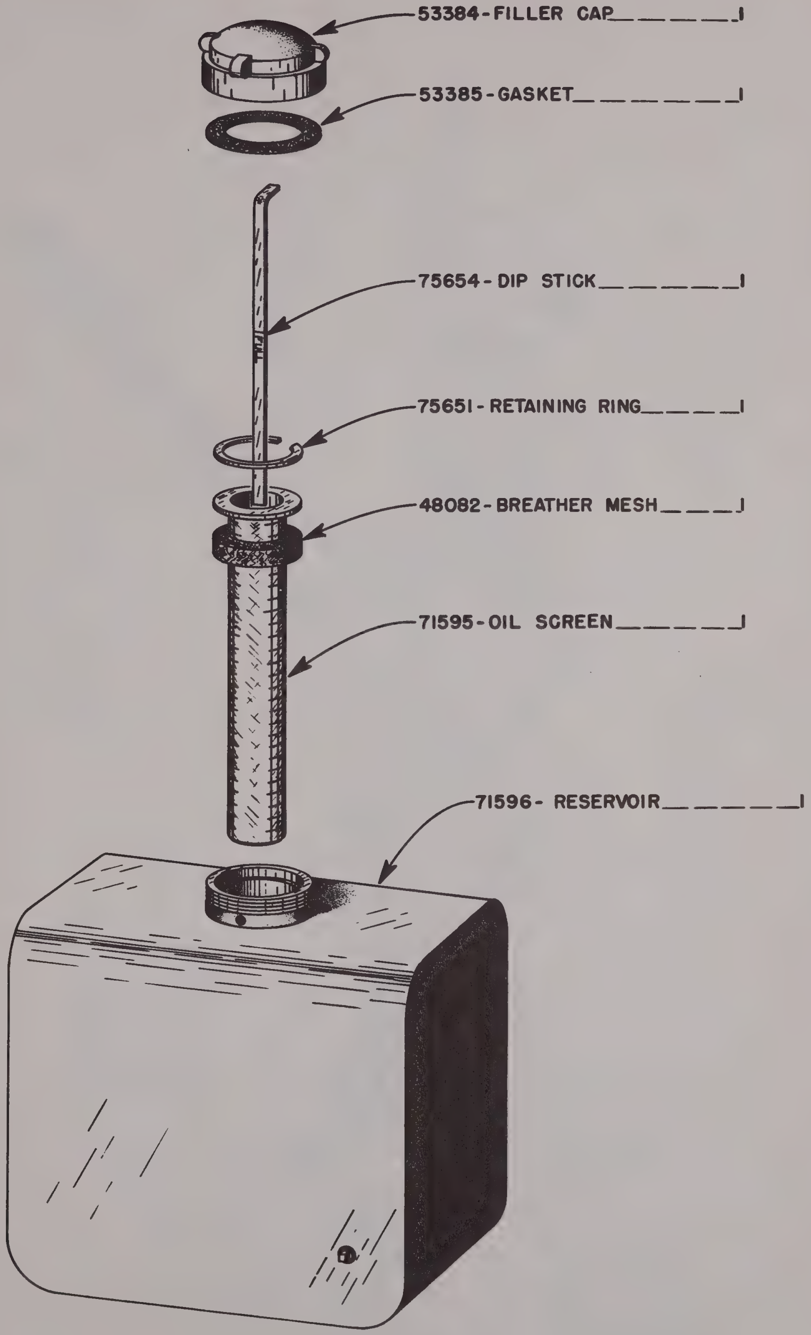
Hydraulic Power Assembly Complete #CR-2864D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	75644	1	Hydraulic Unit
2	CR-2865B	1	Mounting Stand
3		1	Woodruff Key #13
4		4	1/2"-20 N.C. Hex. Hd. Cap Screw x 1 1/4" Lg.
5		4	1/2" Lockwasher
6		4	1/2" Plain Washer
7		1	3/8"-16 N.C. Hex. Hd. Cap Screw x 1" Lg.
8		1	3/8"-16 N.C. Hex. Nut
9		2	3/8" Lockwasher
*10		1	Flexible Push-Pull Cable
11		1	1/4" x 1/4" Key x 2" Lg.
12		1	3/8"-16 N.C. Hex. Hd. Cap Screw x 1 1/4" Lg.
13	CR-2867A	1	Clip Belt Guard
14		4	3/4" Std. Flat Washer
15	CR-2905A	1	24 Tooth Pulley
16	CR-2903A	1	Drive Belt
17	CR-2904A	1	17 Tooth Pulley
18	CR-2866C	1	Belt Guard
19		5	5/8"-11 N.C. Hex. Hd. Cap Screw x 1 3/4" Lg.
20		5	5/8"-11 N.C. Hex. Nut
21		5	5/8" Lockwasher
22		2	1" NPT. Std. Pipe Plug
23		1	3/8"-16 N.C. Hex. Hd. Cap Screw x 1 1/2" Lg.
24	CR-2900B	1	Belt Adjuster Pad
25	CR-2901A	1	Belt Adjuster Screw
26		1	1"-14 N.F. Hex. Jam Nut
27	CR-2902A	1	Belt Adjuster Strut
28	ASD-1005-6	1	Pin
29		2	7/32" Dia. Cotter Pin x 1 1/4" Lg.
30	CR-2898B	1	Mtg. Base

*Listed with boom hoist controls

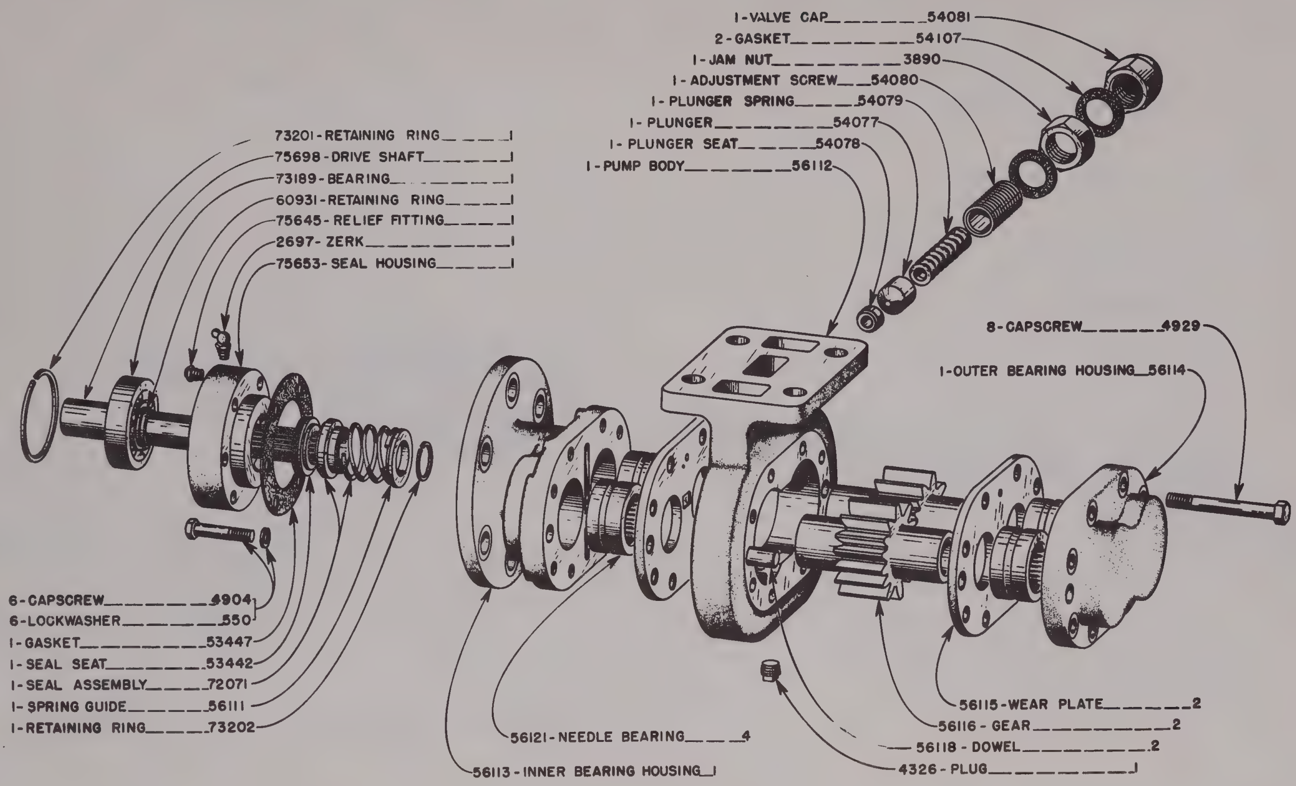

1-RESERVOIR_______72430
(SEE PLATE 3119)
1-GASKET________54888
4-STUD________54065
74021-VALVE ASSEMBLY___1
(SEE PLATE 2187)
54064-GASKET_______1
75648-PUMP________1
(SEE PLATE 3120)
4-LOCKNUT______57699

75644-HYDRAULIC UNIT, MODEL HA 25


53384-FILLER CAP 1
53385-GASKET 1
75654-DIP STICK 1
FULL
75651-RETAINING RING 1
48082-BREATHER MESH 1
71595-OIL SCREEN 1
71596- RESERVOIR 1

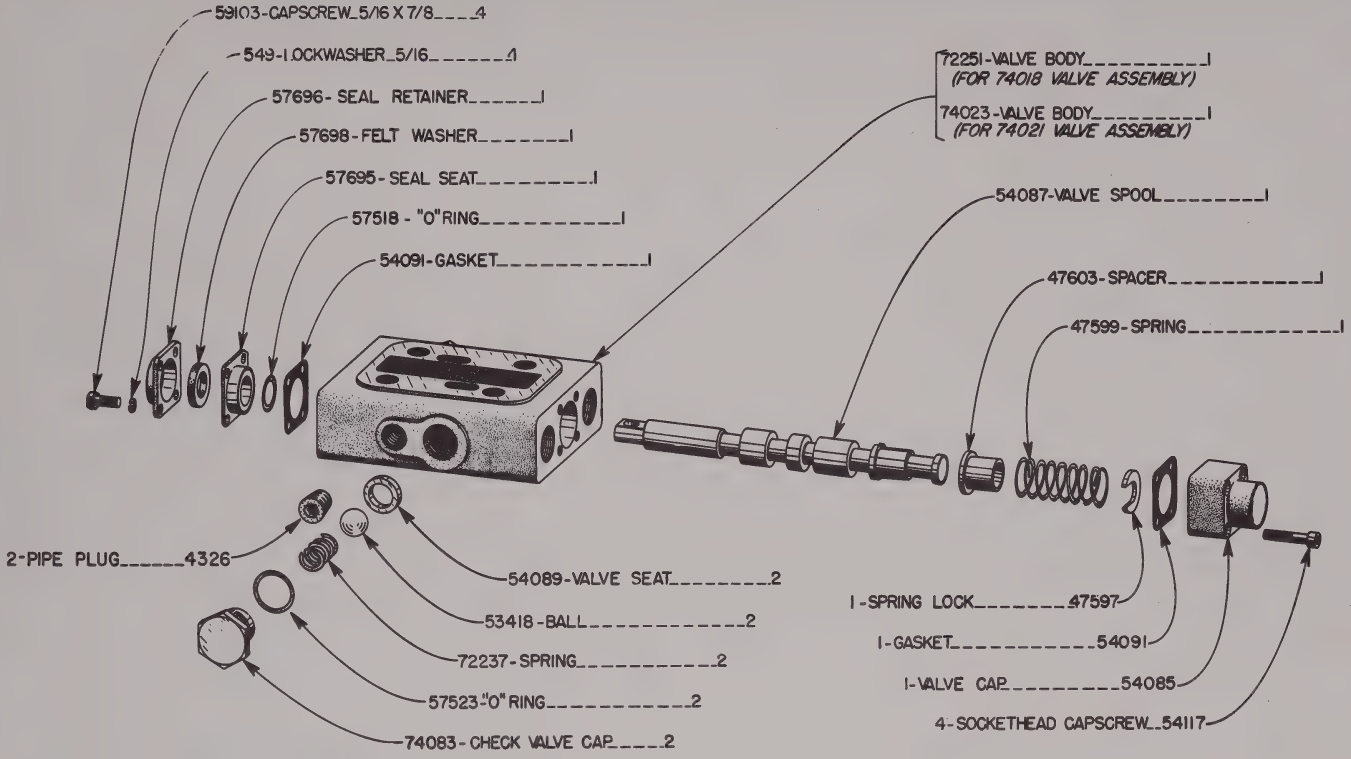
72430-RESERVOIR GROUP

P. 3119


1-VALVE CAP 54081
2-GASKET 54107
1-JAM NUT 3890
1-ADJUSTMENT SCREW 54080
1-PLUNGER SPRING 54079
1-PLUNGER 54077
1-PLUNGER SEAT 54078
1-PUMP BODY 56112
73201-RETAINING RING 1
75698-DRIVE SHAFT 1
73189-BEARING 1
60931-RETAINING RING 1
75645-RELIEF FITTING 1
2697-ZERK 1
75653-SEAL HOUSING 1
8-CAPSCREW 4929
1-OUTER BEARING HOUSING 56114
6-CAPSCREW 4904
6-LOCKWASHER 550
1-GASKET 53447
1-SEAL SEAT 53442
1-SEAL ASSEMBLY 72071
1-SPRING GUIDE 56111
1-RETAINING RING 73202
56121-NEEDLE BEARING 4
56113-INNER BEARING HOUSING 1
56115-WEAR PLATE 2
56116-GEAR 2
56118-DOWEL 2
4326-PLUG 1

75648-HYDRAULIC PUMP, MODEL HA-25

P. 3120


59103-CAPSCREW_5/16 X 7/8____4
549-LOCKWASHER_5/16_______4
57696- SEAL RETAINER_______1
57698-FELT WASHER________1
57695-SEAL SEAT__________1
57518 - "O" RING___________1
54091-GASKET____________1
72251-VALVE BODY__________1
(FOR 74018 VALVE ASSEMBLY)
74023-VALVE BODY__________1
(FOR 74021 VALVE ASSEMBLY)
54087-VALVE SPOOL_________1
47603-SPACER_____________1
47599-SPRING_____________1
2-PIPE PLUG______4326
54089-VALVE SEAT_________2
53418-BALL______________2
72237-SPRING____________2
57523-"O" RING___________2
74083-CHECK VALVE CAP_____2
1-SPRING LOCK________47597
1-GASKET____________54091
1-VALVE CAP__________54085
4-SOCKETHEAD CAPSCREW__54117

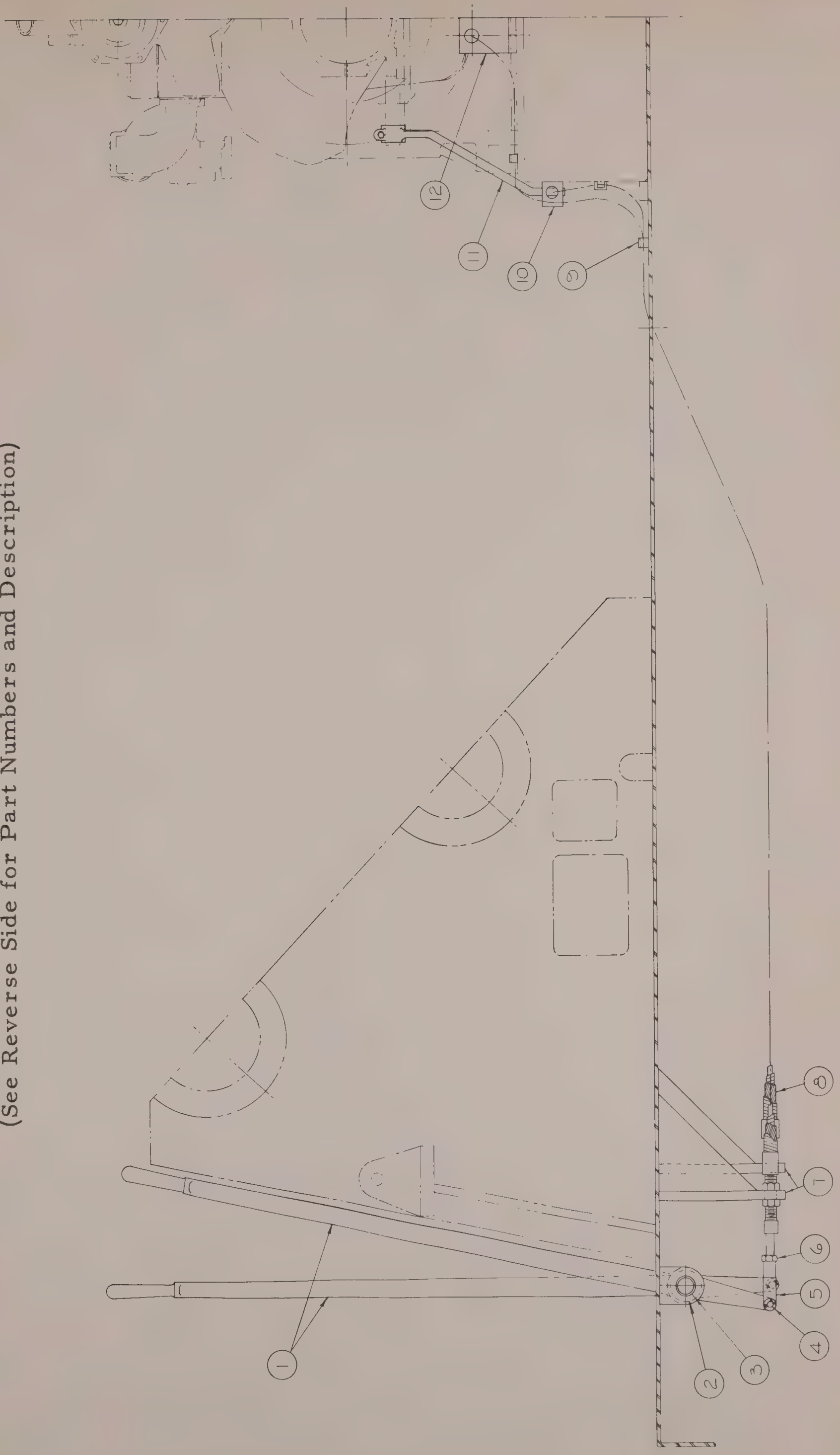
74018 VALVE ASSEMBLY *(WITH SURGE-CONTROL VALVES)*
74021 VALVE ASSEMBLY *(WITHOUT SURGE-CONTROL VALVES)*

P.2187

BOOM HOIST AND ENGINE CLUTCH CONTROL ASSEMBLY

(Applies Only To Machines With Hydraulic Power Boom Hoist)

(See Reverse Side for Part Numbers and Description)



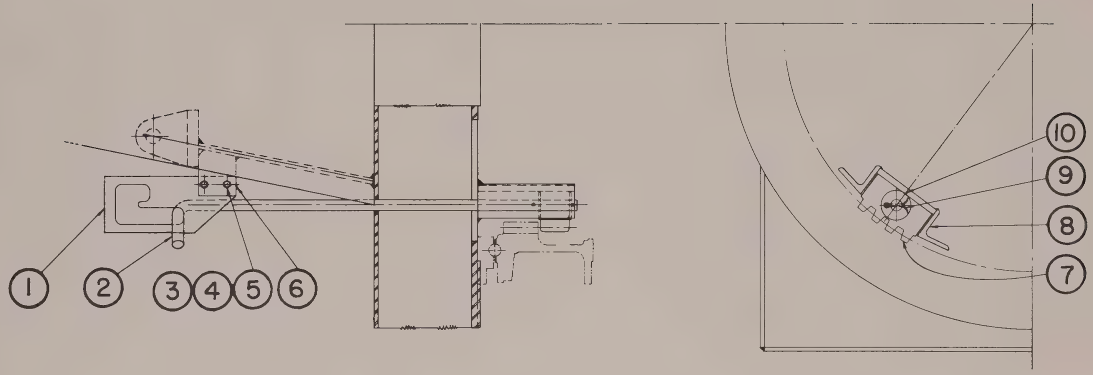
Boom Hoist and Engine Clutch Control Assembly - Complete #40-2871D
(Applies Only To Machines With Hydraulic Power Boom Hoist)
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2052B	2	Control Lever
2	66-2536A	1	Spacer (Between Levers)
3	ASD-1029	2	Bronze Bushing
4		4	Yoke Pin Assembly - Buckeye #36
5	66-2541A	4	Adjustable Yoke End
6		4	3/8"-24 N.F. Hex Jam Nut
*7	66-2507B	2	Anchor Bracket
8	CR-2586B-4	1	1/4" Push-Pull Cable x 138" Lg. (For Engine Clutch)
	CR-2586B-5	1	1/4" Push-Pull Cable x 150" Lg. (For Boom Hoist Control)
**9	66-2608A	5	Clip
**10	CR-2546AA-2	1	Anchor Bracket
11	CR-2046A	1	Lever
**12		1	Anchor Bracket (See Hydraulic Pump Controls)

*Welded to Base
**Welded to Tank

SWING LOCK ASSEMBLY

See Reverse Side for Part Numbers and Description



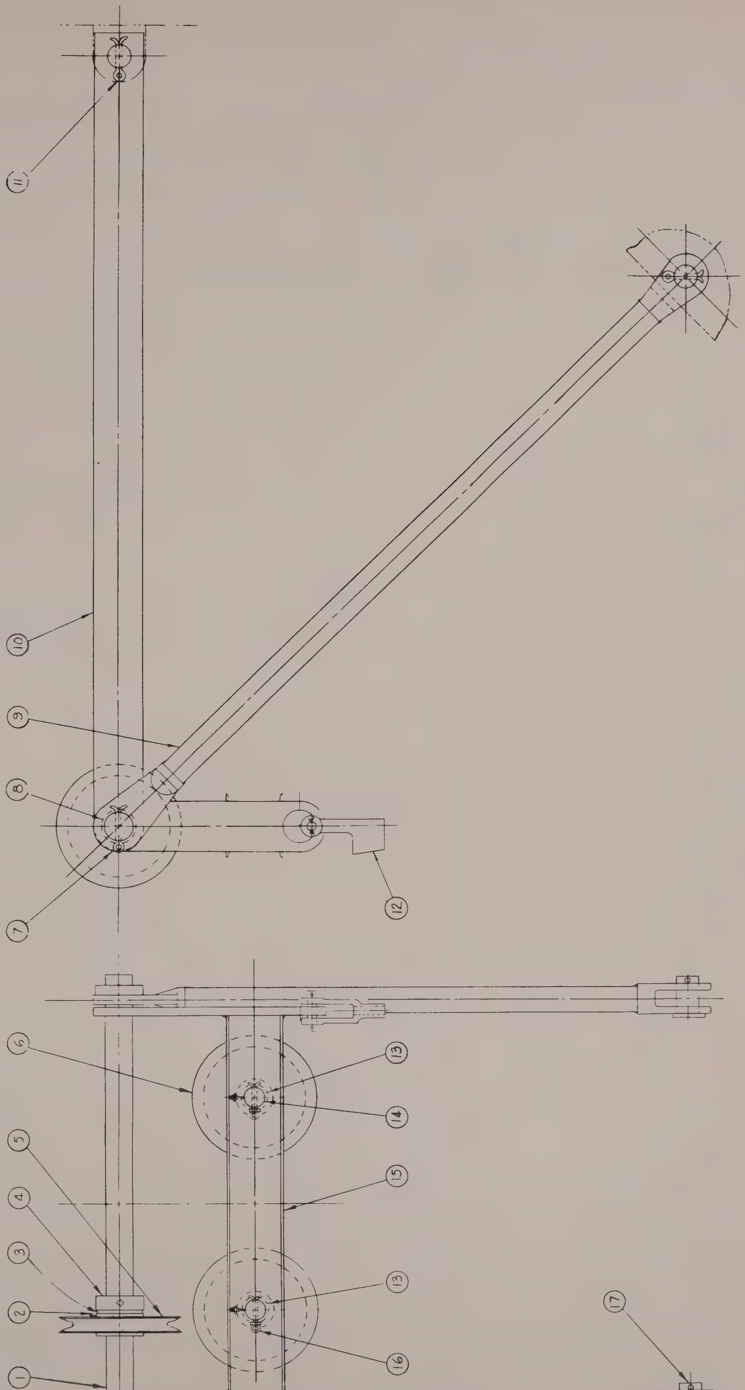
Swing Lock Assembly Complete #66-2605D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2475A	1	Latch
2	66-2474B	1	Gear Segment Shift Rod
3		2	1/2"-13 N.C. Hex Hd. Bolt - 1 1/2" Lg.
4		2	1/2"-13 N.C. Hex Nut
5		2	1/2" Std. Lock Washer
*6	66-2476A	1	Bracket
7	66-2506B	1	Gear Segment
*8	66-2473B	1	Gear Segment Guide
9		2	3/8" Cotter Pin 1 1/2" Lg.
10		2	1" Std. Cut Washer

*Welded to Revolving Base

GANTRY FRAME ASSEMBLY

See Reverse Side for Part Numbers and Description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When Ordering Parts Always give Serial Number of Machine

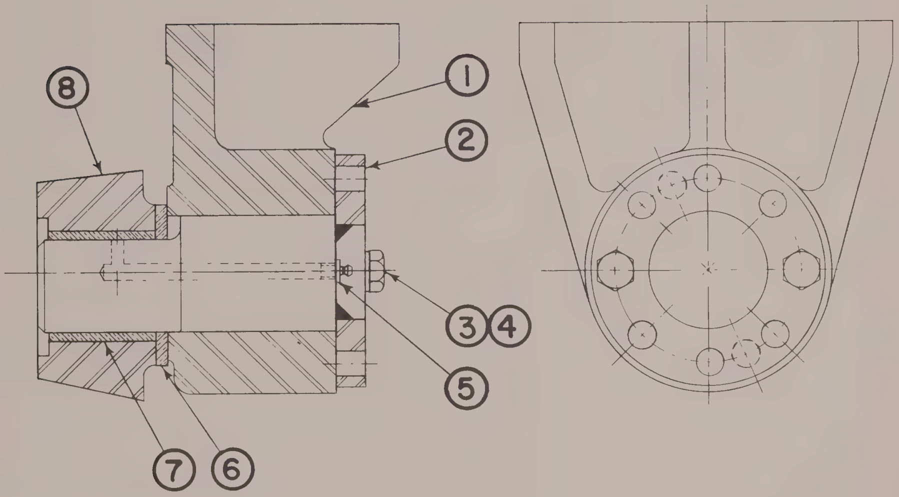
WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

Gantry Frame Assembly - Complete #66-2054D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2058B	1	Shaft
2		3	#1610 Alemite Fitting
3	17-755	1	Washer
4		1	2 1/2" Std. Shaft Collar
5	66-2057B1	1	Sheave
6	66-2057B2	2	Sheave
7		2	Cotter Pin 1/2 x 3 1/2" Lg.
8	17-792A-2	1	Bushing
9	CR-2467CA-1	2	Front Leg
10	CR-2467CA-2	2	Rear Leg
11		4	Cotter Pin 1/2" x 3" Lg.
12		1	Open Type Wedge Socket Assembly Fuller Mfg. Co. #Woo
13	66-2060A	2	Bushing
14	ASD-1020-1	2	Pin
15	66-2055C	1	Gantry Head Frame
16		2	Cotter Pin 3/8" x 3" Lg.
17	66-2576A	4	Pin

Cone Roller - Style #2

(See Reverse Side for Part Numbers and Description)



Cone Roller Assembly - Style #2 Complete #66-2148B

(See Reverse Side for Illustration)

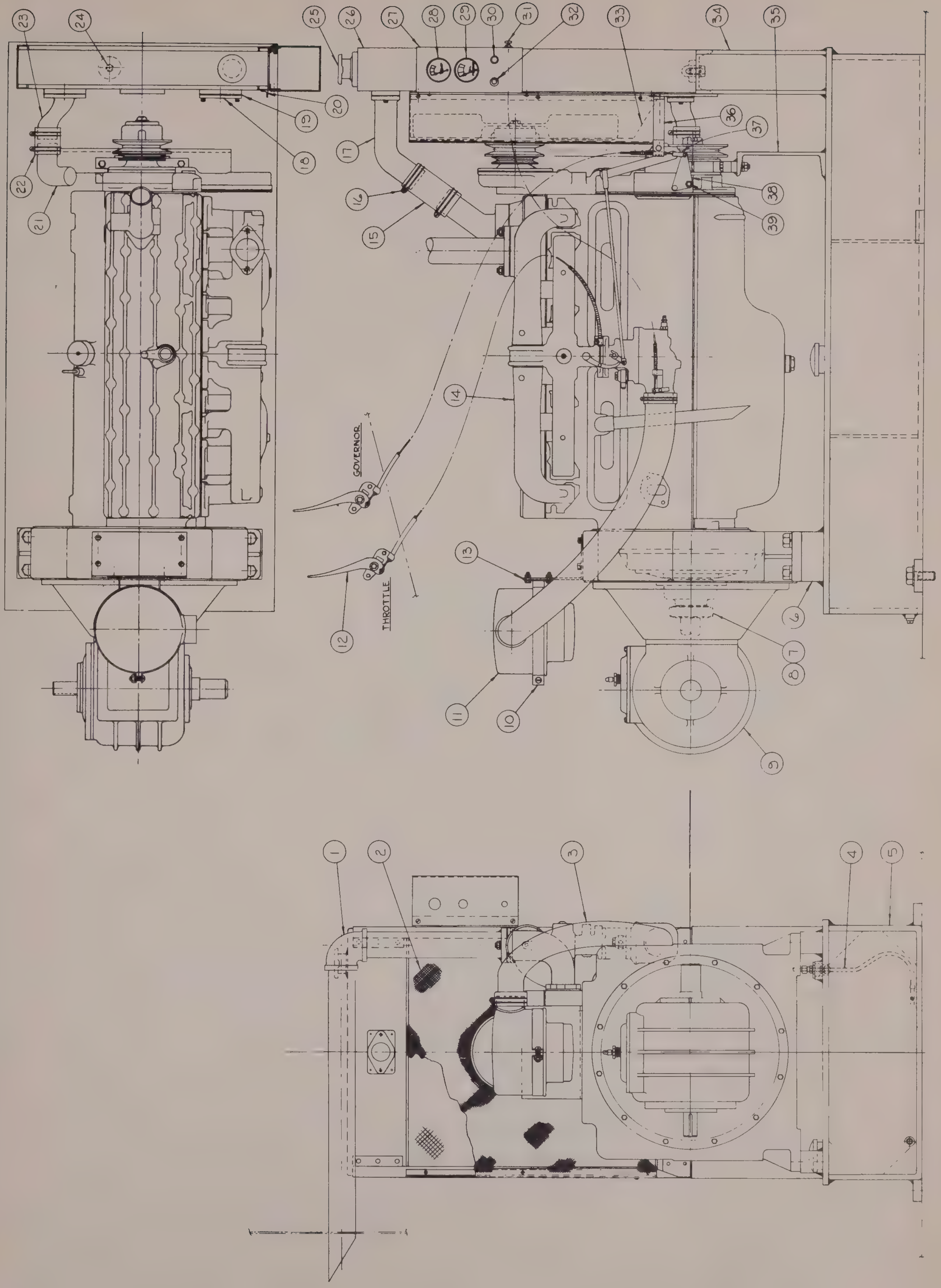
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
*1	66-2478B	1	Roller Bracket
2	66-2479B	1	Roller Shaft
3		2	1/2"-13 N.C. Hex Hd. Cap Scr. 1 1/2" Lg.
4		2	1/2" Lockwasher
5	#1610	1	Alemite Fitting 1/8 N.P.T.
6	17-058B	1	Washer
7	17-012D	1	Bushing
8	17-064A	1	Roller

*Welded to Revolving Base

POWER PLANT ASSEMBLY

See Reverse Side for Part Numbers and Description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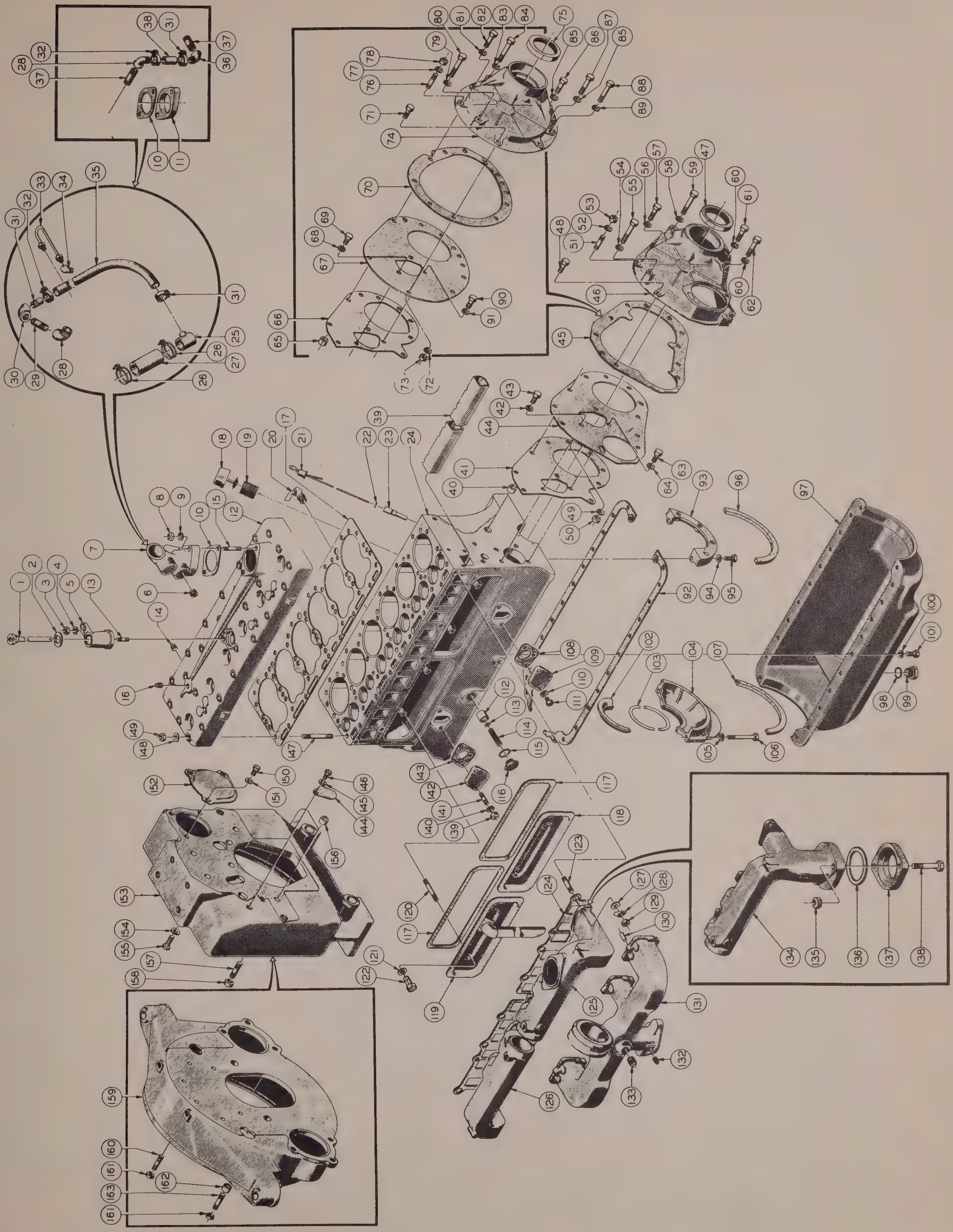
GOVERNOR
THROTTLE

Power Plant Assembly Complete #40-2877D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	40-2854C	1	Exhaust Pipe Assembly
2	40-2875B	1	Fan Guard
3	22-RF-208	1	Air Cleaner Hose (Continental)
4	CR-2879B	1	Gas Tank Connection
5	40-2848C	1	Engine Base and Fuel Tank
6	40-2853A	2	Engine Support (Rear)
7	C-111	1	Engine Clutch Assembly (Twin Disc)
8	5606	1	Pilot Bearing (New Departure)
9	RT-501-B	1	Rt. Angle Power Take-Off (T & G Co.)
10	6096	1	Air Cleaner Bracket (Vortox)
11	S-78	1	Air Cleaner (Vortox)
12	WC-207	2	Throttle & Governor Controls (Western Lever)
13	40-2856A	1	Air Cleaner Mtg. Brkt.
14	M-330-655	1	Continental Engine
15	40-2850A	1	2" I.D. Hose x 5" Lg.
16		6	Universal Hose Clamp
17	CR-2835A	1	Upper Radiator Fitting
18	66-2223A	1	Radiator Cover Plt.
19	66-2610A	3	Radiator Flange Gasket
20	40-2876A	2	Fan Guard Clip
21	CR-2834A	1	Outlet Elbow
22	40-2851A	2	1 3/4" I.D. Hose x 3" Lg.
23	CR-2833A	1	Lower Radiator Fitting
24	10-F-8	1	1/2" N.P.T. Drain Cock (Weatherhead)
25	109212	1	4# Radiator Cap (McCord)
26	DA-193700x2	1	Radiator (McCord)
27	40-2857B	1	Instrument Panel
28	95246	1	Cylinder Hd. Temp. Gage (Stewart-Warner)
29	94726	1	Oil Pressure Gage (Stewart-Warner)
30	3-6021	1	Ignition Switch (Balkamp)
31	1937	1	Choke Control (Elisha Webb)
32	1996027	1	Start Button (Delco-Remy)
33	21T-8146	1	Radiator Shroud (Ford)
34	40-2849B	1	Radiator Support Bracket
35	40-2852A	1	Engine Support Bracket (Front)
36	40-2882B	1	Governor Cable Bracket
37	1948	1	Control Wire Socket (Elisha Webb)
38	40-2883A	1	Speed Control Arm
39	40-2881A	1	Control Arm Stud

CONTINENTAL MOTORS M330-655 SERIES ENGINE ASSEMBLY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Group Assembly Parts List - External View Engine Parts Group

See Reverse Side for Part Numbers and Description.

When Ordering Parts Always Give Serial Number of Machine

WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

Continental Motors M330-655 Series Engine Assembly
Group Assembly Parts List - External View Engine Parts Group
(See Reverse Side for Illustration)
Assembly Consists of:

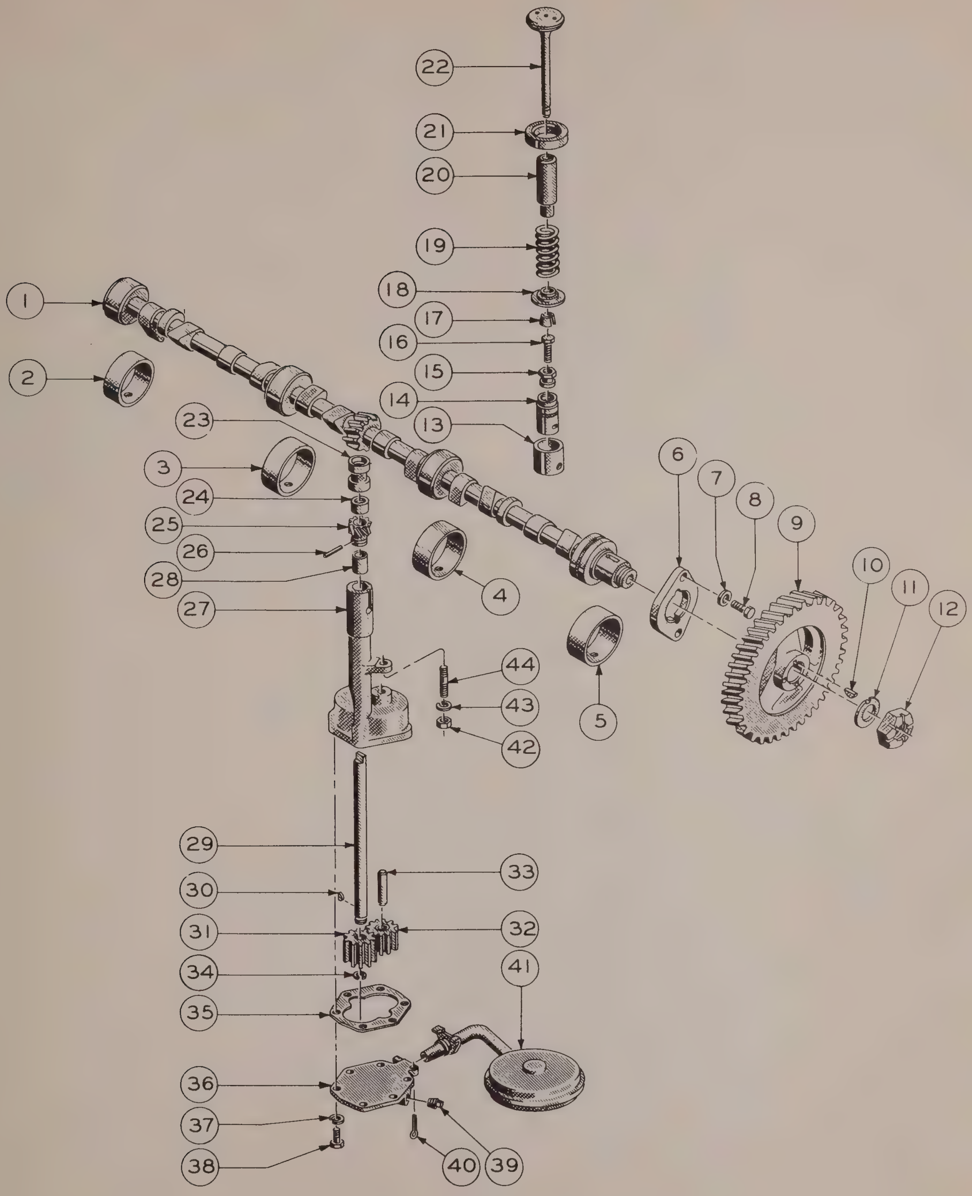
Item	Part No.	Qty.	Name of Part
6	X-101-B	1	Plug - Pipe (1/2 in. Counter Sunk)
7	B427K-403	1	Elbow - Outlet
8	X-1802-G	2	Nut
9	X-203	2	Washer - Lock
10	E600K-215	1	Gasket
12	M600A-449	1	Head - Cylinder
14	X-101-B	1	Plug - Pipe (1/2 in. Counter Sunk)
15	X-4235	2	Stud
16	X-102	1	Plug - Pipe, 3/8 in. Ext. Head
17	M600A-424	1	Gasket - Cylinder Head
18	D600L-2270	1	Cap Assembly - Oil Filler
19	X-12210	1	Nipple - Close
20	X-1005	1	Cock - Drain
21	M600L-2020	1	Rod Assembly - Oil Gauge
22	K404L-210	1	Felt
23	10EL-227	1	Support - Oil Gauge Rod
24	*M600A-4601A	1	Cylinder & Crankcase
	**M600A-4601C	1	Cylinder & Crankcase
	***M600A-4601 I	1	Cylinder & Crankcase
25	B427K-305	1	Tee - Water Inlet
26	X-2354	2	Clamp - Hose
27	B405K-202	1	Hose - Inlet Tee to Pump
28	X-12300	1	Elbow - Street
29	X-12404	1	Nipple
30	X-12299	1	Elbow - Water Outlet
31	X-12390	1	Nipple
32	R600K-231	1	Clamp - Hose
33	M330K-2310	1	Tube Assembly - Water Pump Vent
34	X-5075	1	Elbow - Water Pump Vent Tube
35	X-2431	1	Hose - Outlet Elbow to Tee
39	M600K-3060	1	Tube Assembly - Cylinder Water Distribution
40	7TC-215	2	Dowel - Ring
41	M600B-305	1	Gasket
42	X-203	2	Washer - Lock
43	6FK-131	2	Screw
44	M600B-312	1	Plate - End, Crankcase (Front)
45	M600B-313	1	Gasket
46	M600B-4103	1	Cover Assembly - Gear (Including Cover & Seal)
47	M600L-214	1	Seal
48	X-3295	1	Screw
49	X-203	1	Washer - Lock
50	X-1802-G	1	Nut
51	X-4200	1	Stud
52	X-203	1	Washer - Lock
53	X-1802-G	1	Nut
54	X-203	1	Washer - Lock
55	W4M-109	1	Screw
56	X-203	2	Washer - Lock
57	X-3258	2	Screw
58	X-204	1	Washer - Lock
59	X-3427	1	Screw
60	X-203	4	Washer - Lock
61	X-3252	2	Screw
62	6TB-101	2	Screw
63	X-3386	1	Screw
64	X-204	1	Washer - Lock
92	M600B-432	2	Gasket - Oil Pan
93	M600B-303	1	Block - Filler (Front)
94	X-202	2	Washer - Lock
95	X-3924	2	Screw
96	M600B-201	1	Cork (Front)
97	M600B-4040	1	Pan Assembly - Oil
98	W4B-108	1	Gasket
99	22RB221	1	Plug - Oil Pan Drain
100	X-203	22	Washer - Lock
101	B2B-111	22	Screw
102	E600B-310	1	Guard - Oil (Rear)
103	T427B-201	2	Seal
104	M600B-402	1	Block - Filler (Rear)
105	X-202	2	Washer - Lock
106	X-2957	2	Screw
107	M600B-201	1	Cork (Rear)
108	16EV-201	1	Gasket - Fuel Pump Hole (Front)
109	16EB-202	1	Cover - Fuel Pump Hole (Front)
110	X-335	2	Gasket - Copper Asbestos, 5/16 in.
111	X-3182	2	Screw
112	12KL-228	1	Valve - Relief, Oil Pressure
113	W5L-213	UAR↓	Washer - Adjusting
114	A600L-209	1	Spring
115	W4B-108	1	Gasket
116	12KL-226	1	Plug
117	M600A-303	2	Gasket
118	M600A-315	1	Cover - Tappet Chamber (Front)
119	M600A-3710	1	Cover Assembly - Tappet Chamber (Rear)
120	X-4023	4	Stud
121	X-334	4	Gasket
122	8FA-208	4	Nut
123	X-4353	11	Stud
124	M600E-311	2	Gasket
125	M330E303	1	Manifold - Exhaust (Front)
126	M600E-503	1	Manifold - Exhaust (Rear)
127	M600E-205	6	Washer - Plain
128	M600E-200	5	Crab
129	X-18121	11	Nut
130	22RE-200	2	Dowel
131	M600F-509	1	Manifold - Intake
132	X-100	1	Plug - Pipe, 1/8 in. Ext. Head
133	X-102	1	Plug - Pipe, 3/8 in. Ext. Head
139	X-1801-E	2	Nut
140	X-202	2	Washer
141	X-1954-B	2	Stud
144	8FC-205	1	Cover - Timing Hole
145	X-203	1	Washer - Lock
146	6AB-107	1	Screw
147	X-19070-B	33	Stud
148	3X-X-1353	33	Washer - Plain
149	3X-X-1803-E	33	Nut
153	M600B413	1	Housing (Industrial)
154	X-288	4	Washer - Lock
155	X-3466	4	Screw
156	M600B-202	2	Ring - Dowel
157	X-4442	2	Stud
158	X-18239	2	Nut

↓ Use as required.

*The "A" Cylinder & Crankcase Assembly includes cylinder & crankcase, bearings, bushings, guides, inserts, support, guard, screws, studs, plugs and pins.

**The "C" assembly includes all parts in the "A" assembly plus pistons and rings.

***The "I" assembly includes all parts in the "C" assembly with valves, springs, locks, retainers and tappet assembly.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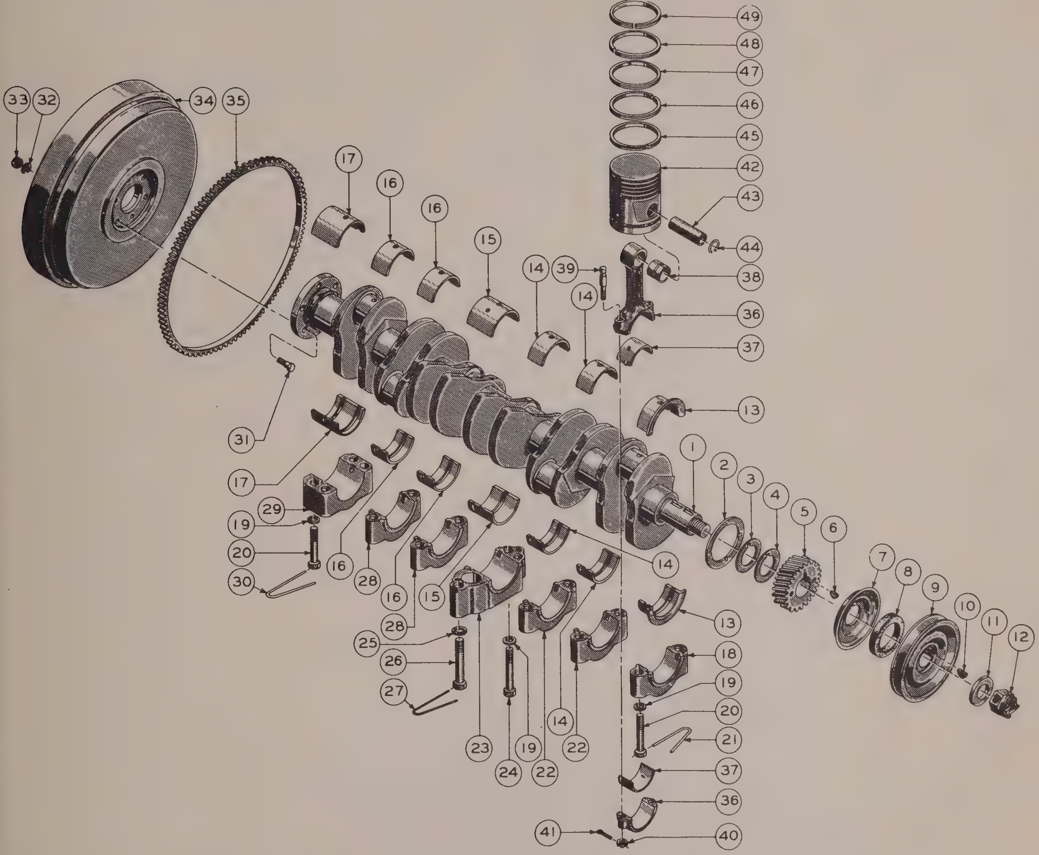
Camshaft and Oil Pump Parts Group

See Reverse Side for Part Numbers and Description

Continental Motors M330-655 Series Engine Assembly
Camshaft and Oil Pump Parts Group
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	M600I-409	1	Camshaft
2	M600G-208	1	Bushing - Camshaft (Rear)
3	M600G-206	1	Bushing - Camshaft (Intermediate Rear)
4	M600G-207	1	Bushing - Camshaft (Intermediate Front)
5	M600G-205	1	Bushing - Camshaft (Front)
6	M600I-202	1	Plate - Thrust, Camshaft
7	X-203	2	Washer - Lock
8	6FK-131	2	Screw
9	M600H-302	1	Gear - Timing, Camshaft
10	X-507	1	Key - Woodruff
11	M600I-215	1	Lock - Nut
12	X-18294	1	Nut
13	M600I-203	12	Guide - Valve Tappet
	M600I-2240	12	Tappet Assembly - Valve
14	M600I-311	12	Tappet (One Required Per Assembly)
15	Y400I-212	12	Nut (One Required Per Assembly)
16	Y400I-213	12	Screw - Adjusting (One Required Per Assembly)
17	M600I-206	12	Lock - Retainer, Valve Spring
18	M600I-205	12	Retainer - Valve Spring
19	A600I-338	12	Spring - Valve (Intake and Exhaust)
20	M600I-228	6	Guide - Valve Stem (Exhaust)
	M600I-201	6	Guide - Valve Stem (Intake)
21	M600A-248	6	Insert - Valve Seat (Exhaust) .010 O.S.
22	M600I-339	6	Valve - Intake
	M600I-329	6	Valve - Exhaust
23	M600L-200	1	Bushing - Oil Pump Drive Shaft (in crankcase)
24	M600L-213	1	Sleeve - Oil Pump Bumper
25	M600M-200	1	Gear - Drive, Oil Pump
26	X-17018	1	Pin
	M600L-4061	1	Pump Assembly - Oil
27	M600L-4060	1	Body Assembly - Oil Pump (Body & Bushing)
28	D600G-274	1	Bushing
29	M600L-300	1	Shaft - Drive, Oil Pump
30	X-504	1	Key - Woodruff No. 5
31	M600H-214	1	Gear - Driver, Oil Pump
32	M600H-215	1	Gear - Idler, Oil Pump
33	E600L-235	1	Stud - Oil Pump Idler Gear
34	D600L-204	1	Ring - Snap, Oil Pump Drive Shaft
35	C400L-231	1	Gasket
36	M600L-311	1	Cover - Oil Pump
37	X-201	6	Washer - Lock
38	X-3107	6	Screw
39	X-101	1	Plug - Pipe, 1/4 (Ext. Head)
40	X-619	1	Pin - Cotter
41	M600L-313	1	Float-O-Assembly
42	X-1802-G	1	Nut
43	X-203	1	Washer - Lock
44	X-19003	1	Stud
	M600I-234	12	Extension Valve Lock
	M600I-235	6	Extension Valve Cap

CONTINENTAL MOTORS M330-655 SERIES ENGINE ASSEMBLY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Internal View Engine Parts Group

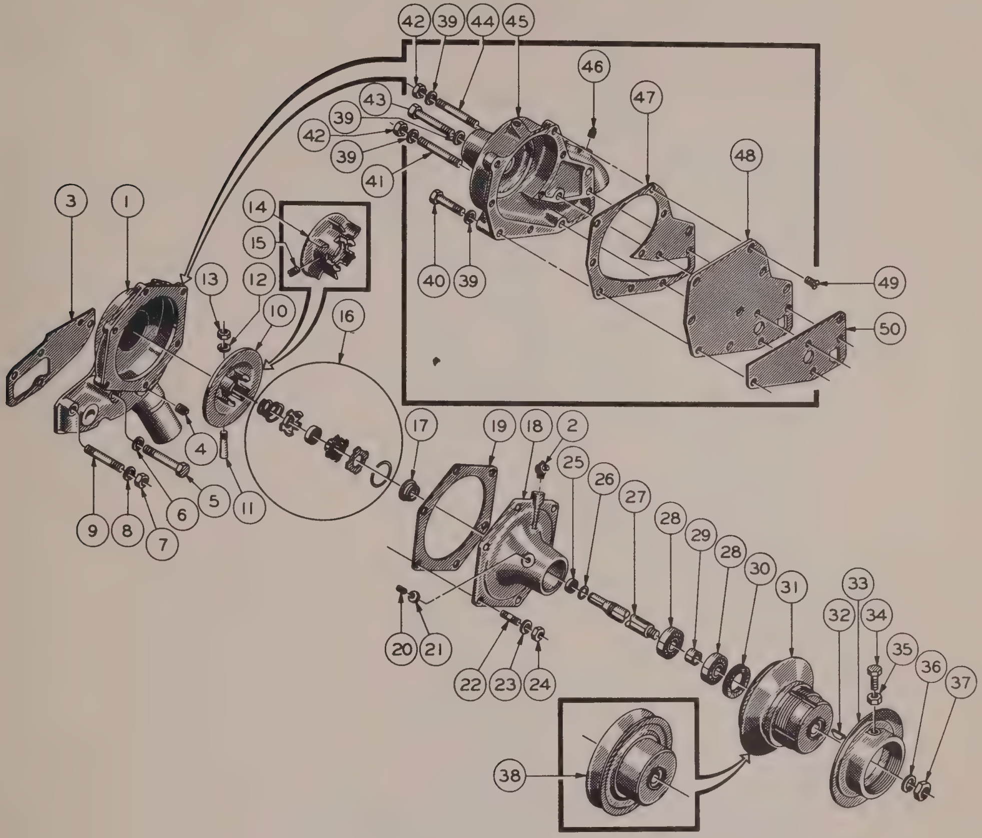
See Reverse Side for Part Numbers and Description

Continental Motors M330-655 Series Engine Assembly
Internal View Engine Parts Group
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	M600C-501	1	Crankshaft
2	M600C-200	1	Washer - Thrust
3	20RC-215	UAR*	Shim - Thrust, Crankshaft (.002 in.)
4	20RC-216	UAR*	Shim - Thrust, Crankshaft (.008 in.)
5	M600H-300	1	Gear - Timing, Crankshaft
6	X-531	1	Key - Morton
7	K600C-201	1	Thrower - Oil, Crankshaft
8	M600K-212	1	Seal - Dust
9	M600K-334	1	Pulley - Fan Drive
10	X-531	1	Key - Morton
11	X-14162	1	Washer
12	K600-O-200	1	Jaw-Starting, Crankshaft
13	M600G-3241	1	Bearing - Main, Crankshaft (Front - Upper & Lower)
14	M600G-3261	2	Bearing - Main, Crankshaft (Intermediate Front - Upper & Lower)
15	M600G-3281	1	Bearing - Main, Crankshaft (Center - Upper & Lower)
16	M600G-3261	2	Bearing - Main, Crankshaft (Intermediate Rear - Upper & Lower)
17	M600G-3301	1	Bearing - Main, Crankshaft (Rear - Upper & Lower)
18	M600B-301	1	Cap - Bearing, Crankshaft (Front)
19	3X-B2B-110	16	Washer - Plain
20	X-3516	14	Screw
21	X-1333-A	5	Wire - Lock, No. 19 x 10 in. (Front & Intermediate)
22	M600B-300	2	Cap - Bearing, Crankshaft (Intermediate Front)
23	M600B-400	1	Cap - Bearing, Crankshaft (Center)
24	X-3508	2	Screw
25	X-14179	1	Washer - Plain
26	X-3553	1	Screw
27	X-1333-T	1	Wire - Lock (Center)
28	M600B-300	2	Cap - Bearing, Crankshaft (Intermediate Rear)
29	M600B-302	1	Cap - Bearing, Crankshaft (Rear)
30	X-1333-H	2	Wire - Lock, No. 19 x 12 in.
31	20RC-217	6	Bolt
32	X-296	6	Washer - Lock
33	3X-X-1804-F	1	Nut
34		1	Flywheel
35		1	Gear - Ring
36	K600D-5008	6	Rod & Cap Assembly (Including Bearings, Bushings, Bolts & Nuts)
37	M600G-331	12	Bearing
38	K600G-200	6	Bushing
39	K600D-200	12	Bolt
40	X-18191	12	Nut
41	X-601	12	Pin - Cotter
	**M600A-4191-A	6	Piston Assembly
	***M600A-4191-E	6	Piston Assembly
42	M600A-419	6	Piston
43	M600A-203	6	Pin - Piston
44	K800A-203	12	Ring - Retaining
45	M600A-323	6	Ring - Piston (Bottom Groove, Plain)
46	M600A-322	6	Ring - Piston (Fourth Groove, Oil Ring)
47	M600A-324	6	Ring - Piston (Third Groove - Super Compression)
48	M600A-325	6	Ring - Piston (Second Groove - Plain)
49	M600A-375	6	Ring - Piston (First Groove - Taper)

* Use as required.
** The "A" Piston Assembly includes pistons, pins, retaining rings and piston rings.
*** The "E" Piston Assembly includes pistons, pins and retaining rings.

CONTINENTAL MOTORS M330-655 SERIES ENGINE ASSEMBLY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Water Pump Parts Group

See Reverse Side for Part Numbers and Description

Continental Motors M330-655 Series Engine Assembly
Water Pump Parts Group
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
	M600K-5038	1	Water Pump Complete
1	M600K-503	1	Body - Water Pump
2	X-940	1	Fitting - Grease
3	M600K-323	1	Gasket
4	X-101	1	Plug - Pipe, 1/4 In. Ext. Head
5	W4M-109	2	Screw
6	X-203	2	Washer - Lock
7	X-1802-G	2	Nut
8	X-203	2	Washer - Lock
9	X-3276	2	Stud
10	M330K-234	1	Impeller
11	M330K-204	1	Pin - Taper, No. 10-32
12	X-200-B	1	Washer - Lock
13	X-1896	1	Nut - No. 10-32
16	Y400K-3330	1	Seal Assembly
17	D600G-284	1	Bushing (Pre Finished)
18	M600K-4021	1	Support Assembly
19	M600K-322	1	Gasket
20	F600K-266	1	Screw - Retaining, Bearings
21	X-1800-C	1	Nut - Lock
22	X-4032	6	Stud
23	X-201	6	Washer - Lock
24	X-1800-C	6	Nut
25	M600K-215	1	Retainer - Snap Ring
26	M600K-214	1	Ring - Snap
27	B600K-304	1	Shaft - Water Pump
28	X-13077	2	Bearing
29	M600K-203	1	Spacer
30	M600K-230	1	Seal - Dust, Fan Hub
31	M600K-334	1	Hub - Fan
32	X-599-D	1	Key
33	8SK-306	1	Flange - Adjusting
34	X-3887	1	Screw
35	X-1800-C	1	Nut
36	X-296	1	Washer - Lock
37	X-1804-F	1	Nut

Continental Motors M330-655 Series Engine Assembly

Oversize and Undersize Parts

To designate a size other than standard, the symbol corresponding to the required oversize or undersize should be listed with the part number and separated with a dash.

Examples:

M600H-200 (Standard)	M600H-200-.010 (Oversize)
M600H-200 (Standard)	M600H-200-.030 (Undersize)

OVERSIZE PISTONS

Cast Iron		Aluminum
.010		.010
.020		.020
.030		.030
.040		.040
.050		.060
.060		
S.F.	(Semi-Finished)	S.F.

OVERSIZE PISTON RINGS

.010
.020
.030
.040
.050
.060

OVERSIZE PISTON PINS

.003
.005
.010

UNDERSIZE BEARINGS (MAIN & ROD)

.002
.010
.020
.030
.040
.060

OVERSIZE GEARS

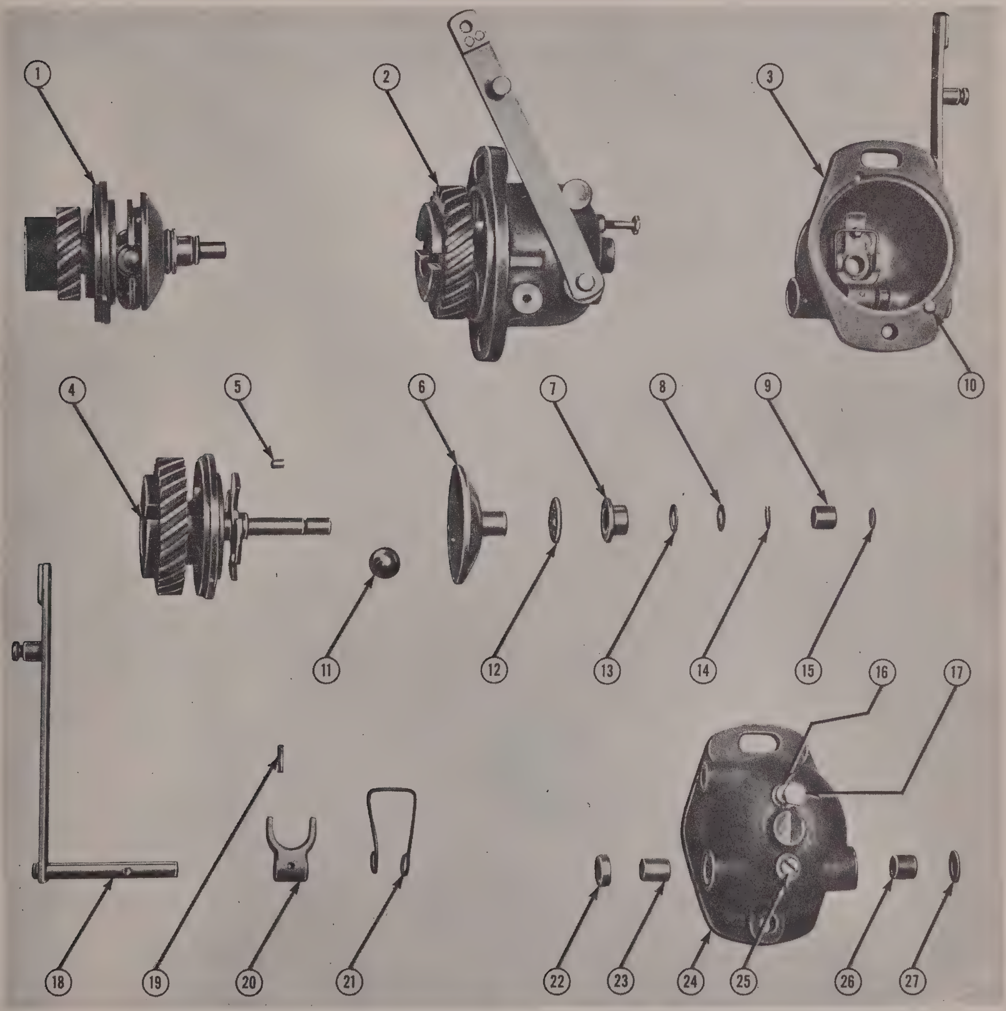
	Identification Mark on Gear
.001	①
.002	②
.003	③
.004	④
.005	⑤
.006	⑥

UNDERSIZE GEARS

	Identification Mark on Gear
.001	⌊1⌋
.002	⌊2⌋
.003	⌊3⌋
.004	⌊4⌋
.005	⌊5⌋
.006	⌊6⌋

CONTINENTAL-NOVI GOVERNOR ASSEMBLY

See Reverse Side for Part Numbers and Description



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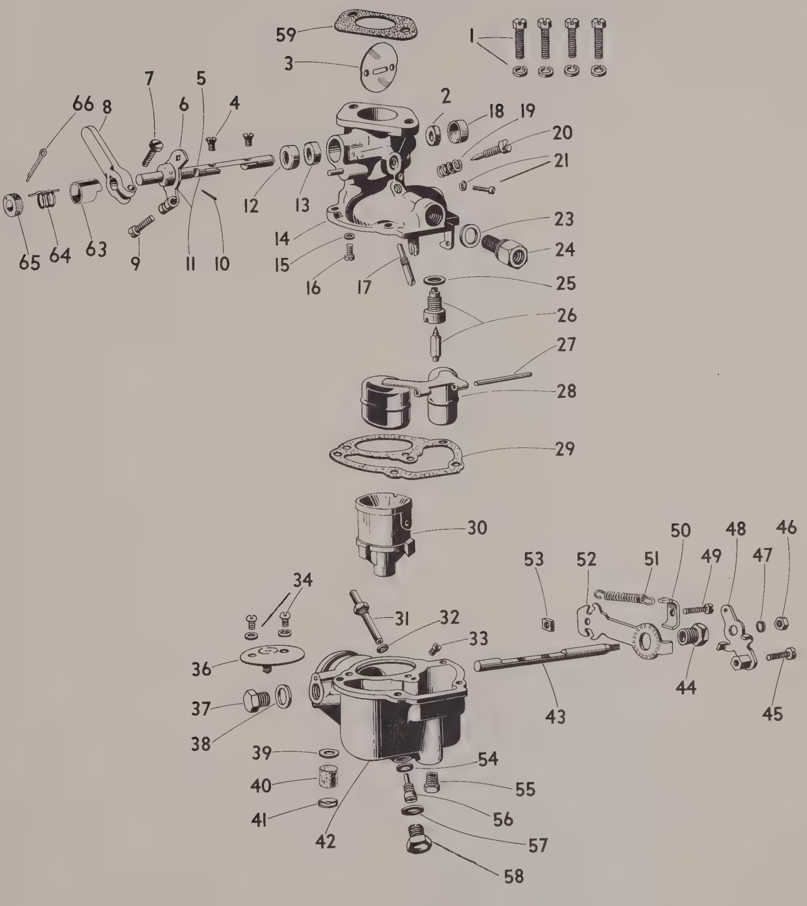
Continental-Novi Governor Assembly
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Name of Part
1	M330S-2170	Works Assembly, Complete
2	M330S-4050	Governor Assembly, Complete
3	M330S-2210	Body & Lever Assembly, Complete
4	M330S-2190	Base Assembly
5	X-1791	Pin, Locating
6	Y400S-244	Race, Upper
7	Z200S-206	Base, Fork
8	Y400S-223	Washer (Thin)
9	F400S-208	Bushing, Drive Shaft
10	X-3665	Screw - Locating
11	Y400S-220	Ball
12	Z200S-208	Bearing, Thrust
13	Y400S-222	Washer (Thick)
14	Y400S-221	Clip
15	Y400S-231	Plate, Thrust
16	X-18072	Nut, Lock, Adjusting Screw
17	F400S-203	Screw Adjusting
18	F162S-2120	Lever Assembly
19	X-1794	Pin, Fork
20	Z200S-207	Fork
21	F400S-216	Spring, Bumper
22	F400S-205	Seal, Oil
23	F400S-204	Bearing, Needle
24	M330S-2150	Body Assembly
25	X-120-B	Plug, Pipe
26	X-7500	Bushing, Lever Shaft
27	X-2262	Plug, Welch

ZENITH CARBURETOR ASSEMBLY

See Reverse Side for Part Numbers and Description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Zenith Carburetor Assembly Complete #S120
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	B2-104A-4	1	BODY - THROTTLE
2	CT57-8	1	Washer - Shaft Packing
3	C131-3x3	1	Retainer - Shaft Packing
4	C131-2	1	Plug - Shaft Hole
5	C130-1	1	Washer - Throttle Shaft Thrust
6	C29-341	1	Shaft & Stop Lever - Throttle
7	T1S8-10	1	Screw - Lever Stop
8	C23-330	1	Shaft - Throttle
9	CR28-80	1	Lever - Throttle Stop
10	CT63-4	1	Taper Pin - Stop Lever
11	C24-10WWx9	1	Lever - Throttle Clamp
12	T8S10-9	1	Screw - Lever Clamp
13	C26-81	1	Driver - Throttle Shaft
14	C117-27	1	Spring - Shaft Driver
15	CR115-10	1	Retainer - Spring
16	CT61-4	1	Cotter Pin - Retainer
17	C21-79	1	Plate - Throttle
18	C136-3	2	Screw - Throttle Plate
19	C150-12	1	Screen & Plug - Fuel Filter
20	T56-10	1	Washer - Filter Plug Fibre
21	C46-38	1	Needle - Idle Adjusting
22	C111-17	1	Spring - Adjusting Needle
23	C85-26	1	Float
24	C120-15	1	Axle - Float
25	C142-15	1	Gasket - Bowl to Body
26	T318S12-12	4	Screw - Bowl to Body Assembly
28	B3-37F-2	1	BOWL - FUEL
29	CT52-7	1	Washer - Intake Drain
30	CT57-12	1	Washer - Drain Felt
31	CT93S-51	1	Retainer - Felt Washer
32	C105-18	1	Shaft - Choke
33	C101-2	1	Plate - Choke
34	T315B6-4	2	Screw - Choke Plate
36	C106-28E	1	Lever - Choke
37	T1S8-6	1	Screw - Lever Swivel
38	T22S8	1	Nut - Choke Shaft
39	T45-8	1	Lockwasher - Shaft Nut
40	C109-2	1	Bracket - Choke
41	C110-1	1	Clamp Bracket Tube
42	T1S8-10	1	Screw - Tube Clamp
43	T21S8	1	Nut - Clamp Screw
44	C140-2	1	Screw - Bracket Assembly
45	C112-12	1	Spring - Choke Lever
46	C138-24	1	Plug - Choke Shaft Hole
47	T56-23	1	Washer - Shaft Hole Plug Fibre
48	C138-23	1	Plug - Main Jet Passage
49	T56-23	1	Washer - Passage Plug Fibre
50	CT91-3	1	Plug - Bowl Drain (1/8" Pipe)
51	B38-24B-28	1	VENTURI (With Cast-in Secondary)
52	T301S8-6	1	Screw - Venturi
54	C52-6-29	1	Jet - Main
55	T56-24	1	Washer - Main Jet Fibre
56	C52-1-29	1	Jet - Economizer
57	T56-4	1	Washer - Economizer Jet Fibre
58	C55-7-12	1	Jet - Idle
59	C66-25-1-70	1	Jet - Discharge
60	T56-48	1	Washer - Discharge Jet Fibre
61	C77-18-14	1	Jet - Well Vent
62	C81-1-50	1	Valve & Seat - Fuel
63	T56-23	1	Washer - Fuel Valve Seat Fibre
64	C141-4-1	1	Gasket - Flange (Not in C181-65 Kit)
65	C181-65	1	KIT - GASKET
	K-S120	1	KIT - SERVICE PARTS

NOTE: Parts indented are part of preceding complete assembly.

NOTE: When ordering parts, please specify the Zenith assembly number (S120).

Fram Oil Filter Assembly Complete F31-P2
Assembly Consists of:

F 31-P2

PARTS

11580 — CAP SCREW

11581 — CAP SCREW WASHER

11559 — COVER

11583 — COVER SPRING

11582 — COVER GASKET

C-31P2 — CARTRIDGE

5214 — FILTER BODY

11563 — STRAPS

11584 — DRAIN PLUG

11562 — CARTRIDGE SPACER

FRAM NO. F31-P2

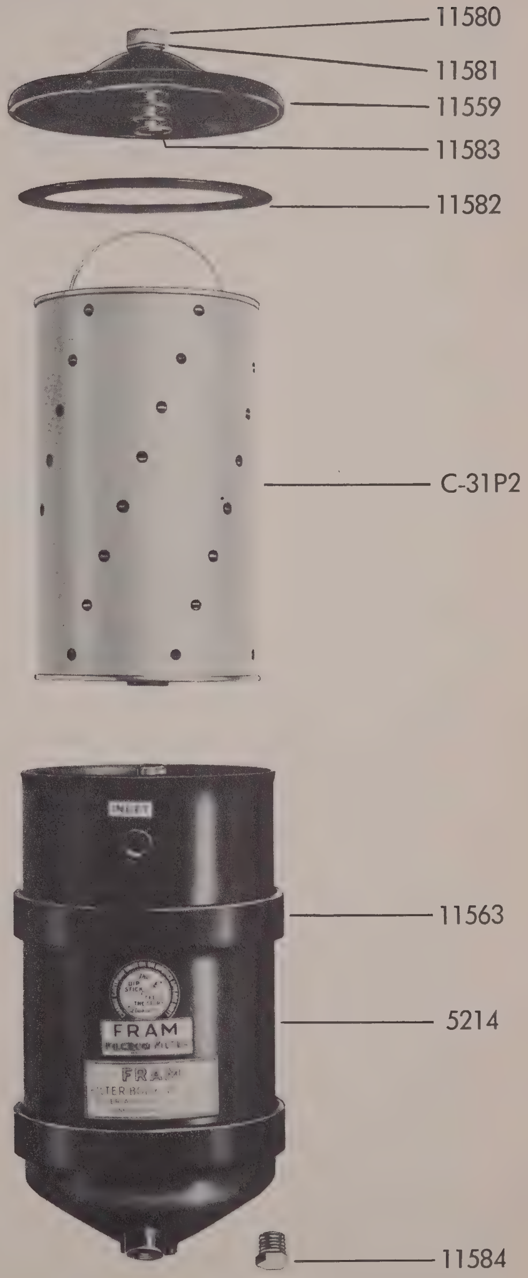
PARTS COMMON NO. 8-E-1010

MOTOR TRANSPORT NO. —

MILITARY STANDARD SENIOR

SERVICE

1. REMOVE COVER
2. REMOVE DRAIN PLUG
3. DRAIN SLUDGE — REMOVE ELEMENT — INSTALL DRAIN PLUG
4. INSTALL NEW ELEMENT
5. INSTALL NEW COVER GASKET #11582
6. REINSTALL COVER
7. ADD OIL TO COMPENSATE FOR NEW CARTRIDGE
8. RUN ENGINE AND CHECK FOR LEAKS.



FUEL PUMP ASSEMBLY

See Reverse Side for Part Numbers and Description

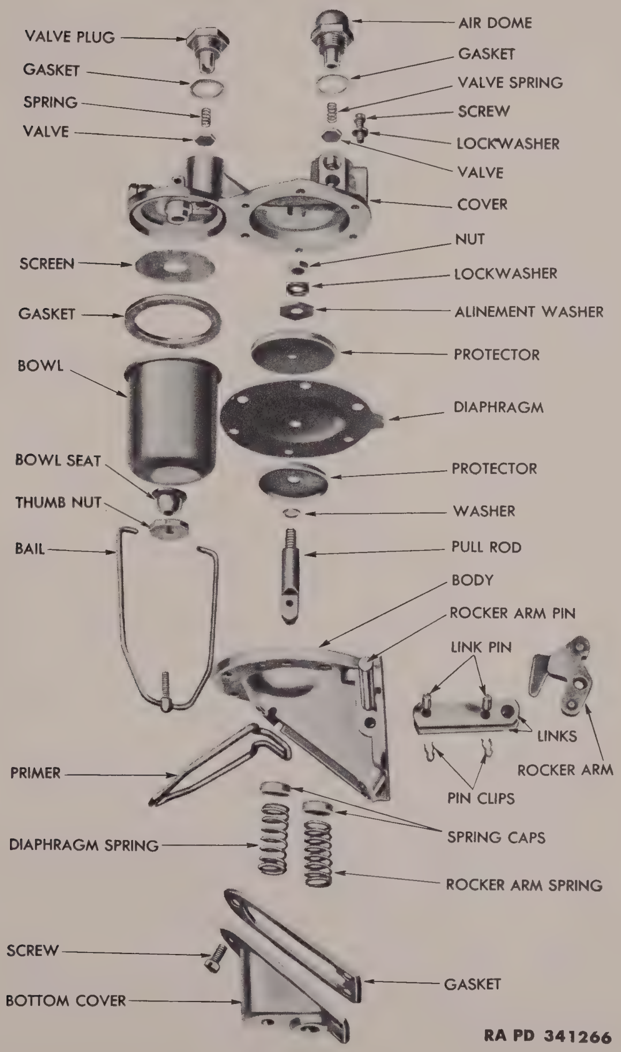

VALVE PLUG
GASKET
SPRING
VALVE
AIR DOME
GASKET
VALVE SPRING
SCREW
LOCKWASHER
VALVE
COVER
NUT
SCREEN
LOCKWASHER
GASKET
ALINEMENT WASHER
PROTECTOR
BOWL
DIAPHRAGM
BOWL SEAT
PROTECTOR
THUMB NUT
WASHER
BAIL
PULL ROD
BODY
ROCKER ARM PIN
LINK PIN
LINKS
ROCKER ARM
PRIMER
PIN CLIPS
SPRING CAPS
DIAPHRAGM SPRING
ROCKER ARM SPRING
SCREW
GASKET
BOTTOM COVER
RA PD 341266

Fig. 6 - Fuel Pump Exploded View, Typical B, D, and O Series Construction

Fuel Pump Assembly Complete #1538265
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	855281	1	Valve Plug - Inlet
2	855739	1	Top Cover & Valve Seat Assembly
3	855918	1	Air Dome
4	855282	2	Valve Plug & Air Dome Gasket
5	855279	2	Valve
6	856270	2	Valve Spring
7	854009	1	Screen
8	5590037	1	Bowl Gasket (854003) - Type FG-1
9	5590156	1	Glass Bowl (1523620) - Type FP-5
10	5590152	1	Bail & Screw - Type FP-1
11	1537656	1	Body
12	855613	1	Rocker Arm
13	1521972	1	Rocker Arm Pin
14	1521288	1	Rocker Arm Pin Washer
15	855574	2	Link
16	855016	2	Link Pin
17	855017	4	Link Pin Clip
18	855573	1	Bottom Cover
19	855585	1	Bottom Cover Gasket
20	1521187	1	Diaphragm Spring
21	855253	1	Rocker Arm Spring
22	855532	2	Spring Cap
23	132108	3	Bottom Cover Screw
24	855493	10	Top Cover Screw
25	855064	10	Top Cover Screw Lockwasher
26	1521720	1	Lower Diaphragm Protector
27	1522280	1	Priming Lever
28	855274	1	Upper Diaphragm Protector
29	855250	1	Pull Rod
30	855213	1	Pull Rod Nut
31	131200	1	Pull Rod Lockwasher
32	855029	1	Diaphragm Alignment Washer
33	855012	1	Pull Rod Gasket
34	855389	1	Diaphragm
35	835683	1	Mounting Gasket
			Service Repair Kit
36	1538166	1	Fuel Pump Repair Kit

Hour Meter Assembly Complete SKD-7419
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	AA-0029	1	Window
2	AA-0032	2	Oil-less Washer 1/2" x 1/16"
3	0403-GE	1	Expansion Plug - 1 3/4"
4	AA-1033-GE	1	Cover
5	DD-1038-XGE	1	Adapter Frame
6	AA-3030-GE	1	Back Cover
7	AA-3032-GE	1	Escutcheon Plate
8	BB-3035-3	1	Name Plate
9	3137-ZnP	2	Washer 3/16" x .025
10	3366	1	Washer 33/64" x .031
11	4005.2	4	Drive Screw #0 x 3/16"
12	AA-4016-P	1	Locating Pin
13	4442	2	Groove Pin 3/32" x 3/4"
14	4442.5	2	Groove Pin 3/32" x 3/8"
15	4461.1	2	Groove Pin 1/16" x 7/16"
16	AA-5008	1	Drive Shaft Collar
17	AA-5008-1	1	Drive Shaft Collar
18	AA-5120	1	Gear Spacer 3/16" x .655
19	BB-5117-11X	1	Worm Gear Assembly
20	BB-7066-10X	1	Drive Shaft
21	AA-7075	1	Hinge Pin
22	8065-X	4	6-32 x 5/16 F.H.M.S. & L.W.
23	8128-X	5	6-32 x 1/2 R.H.M.S. & L.W.
24	4-HMR-1	1	Hourmeter Assembly 1:1000

Continental Motors M330-655 Series Engine Assembly
Distributor Parts List - IBD-4001UT

Part No.	Qty.	Name of Part
CW-4002	1	Ignition Coil
GT-97	1	Felt, Wick
IAH-13	1	Washer, Thrust, Advance Arm
IAU-6	2	Clamp, Lead
IAU-23	1	Arm, Advance
IAU-24	1	Lead Assy., Breaker Spring Clamp
IAU-29	1	Spring, Dist. Cap Contact
IAU-39	2	Holder, Breaker Plate
IAU-52	6	Washer, Cap Sealing
IAU-54	1	Plug, Cap Cover
IAU-56	1	Cover, Dist. Cap
IAU-1004	1	Plate, Breaker
IAU-1055	1	Cap Assy., Dist.
IAU-1057	1	Receptacle & Lead Assy.
IAU-1066	1	Rotor
IAU-1068L	1	Shaft, Drive
IAU-2058B	1	Base Assy., Dist.
IAU-10	1	Washer
IAU-41	1	Plug, Drain
IAU-42	1	Washer, Plug, Drain
IG-579A	2	Bearing, Abs. Bronze
XA-751	1	Seal
IAU-3076L	1	Condenser
IG-90	1	Washer, Thrust, Drive Shaft, Lower
IG-313	1	Washer, Thrust, Drive Shaft, Upper
IG-644A	1	Coupling, Drive, Dist.
IG-676	1	Clamp, Breaker Arm Spring
IG-680	1	Snap Ring, Cam Retaining
IG-796BS	1	Spring Set, Governor Weight
IGC-175	1	Screw, Breaker Spring Clamp, #6-32 x 5/16" Lg.
IGC-2168L	2	Weight, Governor
IGE-15	1	Washer, Breaker Spring Clamp Sc., #6
IGH-28	1	Wick, Felt, Cam Sleeve
IGP-3028FS	1	Contact Set, Breaker
IGS-99	1	Spacer, Cam
IGS-1100LAE	1	Cam & Stop Plate, 6 Cyl. L.H.
IGT-69	1	Spring, Anti-Rattle
SW-213	1	Rivet, Coupling
SW-634A	1	Washer, Plain, Advance Arm Mtg.
12X-194	1	Lockwasher, Spring Clamp Screw, #6
12X-196	2	Lockwasher, Coil Terminal, #10
12X-199	1	Lockwasher, Advance Arm, 1/4" Dia.
19X-464	1	Screw, Advance Arm Mtg., Hex. Hd. 1/4-20 x 3/4" Lg.
X-865A	1	Plug, Pipe
8X-1372	2	Nut, Coil Terminal, Hex. #10-32
X-2878	2	Screw, Breaker Plate Mtg., Fill. Hd. #10-32 x 5/16" Lg.
X-3028	2	Screw, Coil Bracket Mtg., Fill. Hd. #10-32 x 7/16" Lg.
X-3029	6	Screw, Cover Mtg., Fill. Hd. #10-32 x 11/16" Lg.
X-3030	1	Screw, Condenser Mtg., Fill. Hd. #6-32 x 3/16" Lg.
X-3031	1	Screw, Lock, Breaker Contact, Fill. Hd. #8-32 x 3/16" Lg.
X-3032	3	Screw, Cap & Cover Attaching, Fill. Hd. #8-32 x 1" Lg.
X-3090	4	Screw, Receptacle Mtg., Fill. Hd. #6-32 x 13/32" Lg.
XA-744G	1	Seal, "O" Ring, 4 1/2" Dia. O.D., Cover
XA-744P	1	Seal, "O" Ring, 3/4" O.D., Cover Plug
XA-748	1	Gasket, Receptacle Mtg.

Continental Motors M330-655 Series Engine Assembly
Starting Motor Parts List - MAU-4027T

Frame & Field Assembly & Parts Used With:

Part No.	Qty.	Name of Part
GT-20B	2	Bolt, Thru
(MAU-2112A)	1	Frame & Field Assy.
GK-38D	4	Screw, Pole Shoe
MAB-12A*	1	Brush
MAB-30	1	Insulation, Field Connection
MAB-31A	1	Washer, Ins., Term. Stud, Outer
MAB-65	1	Terminal
MAB-85A	1	Bushing, Ins., Term. Stud
MAF-59	1	Connector, Field Coil
MAU-12A*	1	Brush
MAU-33	1	Connector, Brush
MAU-1007G	1	Coil, Field, U.L.
MAU-1008B	1	Coil, Field, L.R.
MAU-1009B	1	Coil, Field, L.L.
MAU-1010C	1	Coil, Field, U.R.
MN-21B	2	Pin, Dowel
MU-28B	1	Stud, Terminal, 5/16-24
MU-37G	1	Washer, Plain, Term. Stud, 5/16
MU-39A	1	Washer, Ins., Term. Stud, Inner
8X-180	2	Nut, Term. Stud, Hex. 5/16-24
12X-1014	2	Lockwasher, Term. Stud, 5/16
12X-199	2	Lockwasher, Thru Bolt, 1/4

Comm. End Head Assembly & Parts Used With:

Part No.	Qty.	Name of Part
MAB-2002E	1	Head Assy., Comm. End
MAD-110	1	Felt
MZ-19C	4	Spring, Brush
MZ-1034CS*	2	Brush, Grounded

*Brush Set, Service MAB-2012FS.

NOTE: Part numbers shown in parenthesis are not recommended for service.

Armature Assembly & Parts Used With:

Part No.	Qty.	Name of Part
MAB-2128A	1	Armature
MU-54	2	Washer, Thrust, 1/32" Thick
X-261	1	Key, Woodruff, #6

Switch Assembly & Parts Used With:

Part No.	Qty.	Name of Part
MBR-40L	1	Connector
SSW-4001T	1	Solenoid Switch
12X-196	1	Lockwasher #10
12X-1014	2	Lockwasher, 5/16
X-2853	1	Nut, Hex. #10-32
X-2976	2	Nut, Hex. 5/16-18
X-20	2	Screw, Switch Mtg., Rd. Hd. #10-32 x 5/16
X-1270A	2	Washer, Switch Mtg. Sc., Skpf. #10

Miscellaneous Parts:

Part No.	Qty.	Name of Part
EBA-8A	1	Bendix Drive Assy.
EB-108A	2	Lockwasher
EB-7819SA	1	Sleeve, Compression
EB-8734A	1	Ring, Take Up
EB-8803A	1	Head, Driving
EB-8805A	1	Spring, Drive
EB-8806A	1	Screw, Spring, Head
EB-8807A	1	Screw, Spring, Shaft
EBA-211A	1	Shaft & Pinion
MAB-1024Y	1	Band, Cover
MAB-2040D	1	Bearing Assy., Intermediate
MG-77A	1	Bearing, Abs. Bronze
PS-1143E	1	Housing Assy., Pinion
MAB-88A	1	Pin, Dowel
MG-77A	1	Bearing, Abs., Bronze
X-2875	1	Nut, Cover Band, Square #10-32
X-2882	1	Screw, Cover Band, Rd. Hd. #10-32 x 1 1/2

Continental Motors M330-655 Series Engine Assembly
Generator Parts List - GDJ-4842AT

Frame & Field Assembly & Parts Used With:

Part No.	Qty.	Name of Part
(GDJ-2109C)	1	Frame & Field Assy.
GBF-55	1	Washer, Ins., Field Term.
GBG-22A	1	Stud, Field Term., #10-32
GBG-27B	1	Lead Assembly
GBG-121A	1	Terminal, 2 Wire
X-1425	2	Terminal
GBG-30	1	Insulation, Field Connection
GBG-38B	8	Screw, Pole Shoe
GCY-27B	1	Bushing, Ins., Field Term.
GCY-28A	1	Bushing, Ins., Arm. Term.
GDJ-66	1	Insulation, Term. Stud, Inner
GDJ-67B	1	Insulation, Term. Stud, Inner
GDJ-68	1	Insulation, Field Ter., Inner
GDJ-136	1	Stud, Arm. Term., 5/16-24
GDJ-1005E	1	Coil Assy., Field, Complete
GDJ-1007C	1	Coil, Field, U.L.
X-1425	1	Terminal
GDJ-1008C	1	Coil, Field, L.L.
GDJ-1009C	1	Coil, Field, L.R.
GDJ-1010E	1	Coil, Field, U.R.
GBG-26	1	Terminal
MU-36A	1	Washer, Ins., Arm. Term.
MU-37G	1	Washer, Plain, Arm. Term., 5/16" Dia.
X-180	2	Nut, Arm. Term., Hex. 5/16-24
X-183B	1	Washer, Plain, Field Term., #10
12X-196	2	Lockwasher, Field Term., #10
12X-1014	2	Lockwasher, Arm. Term., 5/16" Dia.
X-2853	2	Nut, Field Ter., Hex. #10-32
12X-196	1	Lockwasher, Ground Sc., #10
X-2881	1	Screw, Ground, Rd. Hd. #10-32 x 7/16" Lg.

Comm. End Head Assembly & Parts Used With:

Part No.	Qty.	Name of Part
DA-60A	1	Screw, Bearing Retaining
GBG-49C	2	Spacer, Arm. Shaft, C.E. & D.E.
GBG-66B	1	Washer, Bearing Retaining
GCE-40B	2	Washer, Felt, Retaining
GDJ-23B	1	Washer, Spring
GDJ-24	1	Washer, Felt
GDJ-27	1	Gasket, C.E. Cover
GDJ-63D	1	Cover, Comm. End
GDJ-2012BS	1	Brush Set, Service
GDJ-2074BS	1	Head Assy., Comm. End
GBY-34C	4	Arm, Brush

Comm. End Head Assembly (Continued)

Part No.	Qty.	Name of Part
GCE-53A	4	Spring, Brush
X-10	4	Screw, Brush Lead, Rd. Hd. #8-32 x 1/4" Lg.
20X-118	6	Screw, C.E. Head, Fill. Hd. #10-32 x 3/4" Lg.
12X-195	4	Lockwasher, Brush Lead Sc., #8
12X-196	10	Lockwasher, Head Screw & Cover Screw #10
12X-199	1	Lockwasher, Brg. Retaining Sc., 1/4" Dia.
X-489A	1	Oiler
X-1528	1	Bearing, Ball, S.A.E. #205
X-2856	4	Screw, C.E. Cover Fill. Hd. #10-32 x 1/2" Lg.

Armature Assembly & Parts Used With:

Part No.	Qty.	Name of Part
GDJ-2202FT	1	Armature
GFR-56A	1	Spacer, Armature Shaft
PU-39	1	Pulley, Drive
20X-1134	1	Washer, Shaft, D.E., Plain 5/8" Dia.
X-1177A	1	Washer, Shaft, D.E., Skpf. 5/8" Dia.
20X-1178	1	Nut, Shaft, C.E., Hex. 5/8-18

Drive End Head Assembly & Parts Used With:

Part No.	Qty.	Name of Part
GDJ-1073B	1	Head Assy., Drive End
GBG-50	1	Gasket, Brg. Retainer
GBG-57B	1	Retainer, Felt Washer
GBG-58	1	Washer, Felt
GBG-1056F	1	Retainer Assy., Bearing
GBG-56D	1	Retainer, Bearing
GBG-57B	1	Retainer, Felt Washer
GBG-58	1	Washer, Felt
GDJ-73B	1	Head, D.E.
12X-196	4	Lockwasher, Retainer Sc., #10
X-444	1	Bearing, Ball, S.A.E. #305
X-2856	4	Screw, Brg. Retainer, Fill. Hd. #10-32 x 1/2" Lg.
20X-118	6	Screw, D.E. Head, Fill. Hd. #10-32 x 3/4" Lg.
12X-196	6	Lockwasher, Head Screw, #10
X-394	1	Oiler, D.E.

Miscellaneous Parts

Part No.	Qty.	Name of Part
GBG-24M	1	Band, Cover
X-2875	1	Nut, Cover Band, Square #10-32
X-2882	1	Screw, Cover Band, Rd. Hd. #10-32 x 1 1/2" Lg.

NOTE: VRH-4107B-1T Current Voltage Regulator is used with but is not a part of this generator

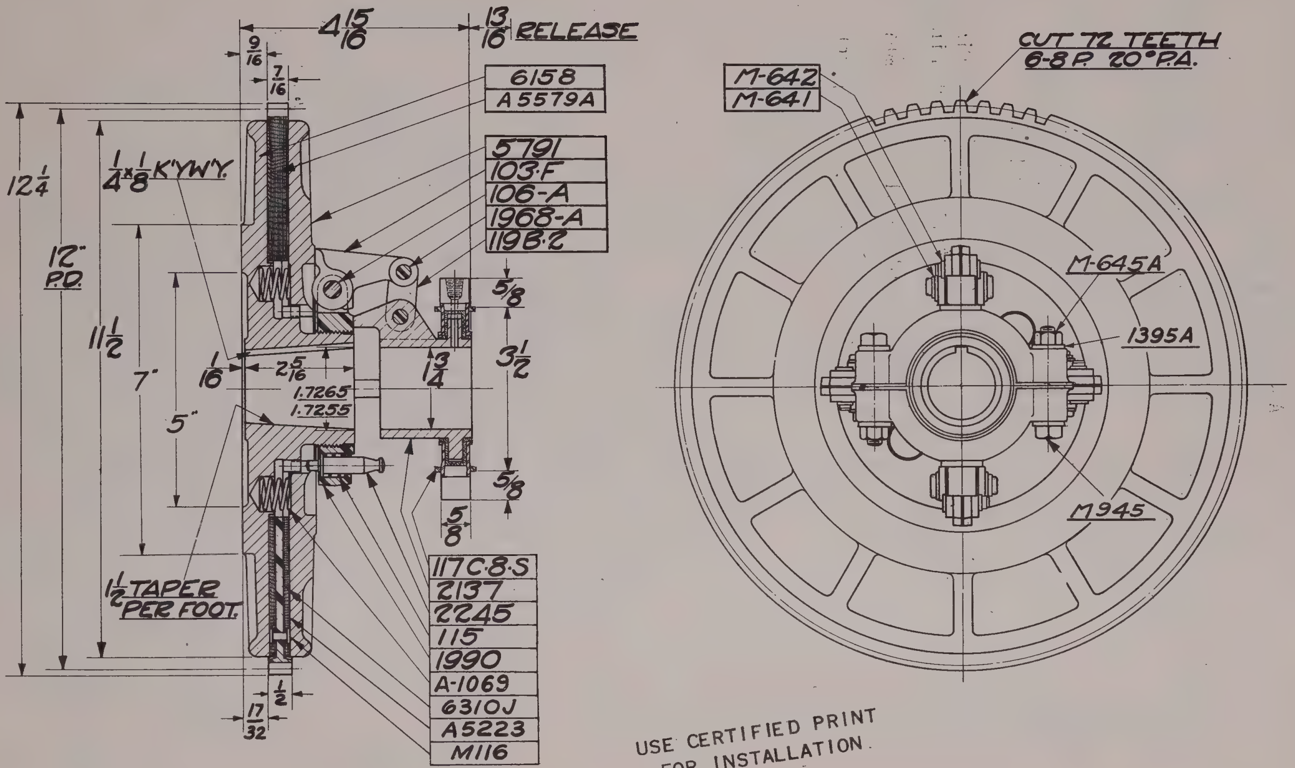
Continental Motors M330-655 Series Engine Assembly
Radio Interference Suppression Kit - Hallet Kit #6024

Part No.	Name of Part
676	#1 Spark Plug Lead
677	#2 Spark Plug Lead
678	#3 Spark Plug Lead
679	#4 Spark Plug Lead
680	#5 Spark Plug Lead
681	#6 Spark Plug Lead
2511	Pitot Tube
CL-6-060-B	Capacitor and Lead (Gen. "Arm.")
3B-4-120-8	Bond Strap
CL-6-060-B	Capacitor & Lead (Reg. "Arm." & "Batt.")
CL-3-060-B	Capacitor & Lead (Ign. Switch)
683	Generator "Armature" Lead
684	Generator "Field" Lead

Continental Motors M330-655 Series Engine Assembly
Regulator Parts List - VRH-4107B-1T

Part No.	Qty.	Name of Part
GAG-138	1	Seal, Lead and Wire
IGW-3138A	1	Condenser
TC-51A	1	Resistance, Carbon, Marked 1
VAD-166	1	Plug, Drain, 1/8
VRA-46	1	Connector, Series Coil
VRA-87A	1	Plate, Name
VRA-109	2	Washer, Rubber, Cover Stud
VRA-139	1	Washer, Plain, Coil Mtg.
VRA-1002B	1	Cover
VRA-1072D	1	Base, Mounting
VRH-19	1	Bracket, Resistor Mounting
VRH-26B	2	Lead, V.R. & C.R. Armature to Base
GRH-50A	1	Gasket, Cover
VRH-1055C	1	Base, Sub
VRH-3008B	1	Coil Assembly, Current Regulator
VRA-15	1	Nut, Knurled, Adjusting, #10-48
VRA-16	1	Screw, Adjusting, #10-48 x 19/32
VRA-17	1	Spring, 16 Coils
VRA-1060B	1	Bracket, Gap Adjusting
VRH-36	1	Bracket, Resistor
VRH-1061B	1	Armature
12X-195	6	Lockwasher, Adjusting Bracket & Bridge Mtg., #8
8X-350	4	Washer, Plain, Adjusting Bracket & Bridge Mtg. #8
8X-878	3	Screw, Adjusting Bracket & Bridge Mtg., Fill. Hd. #8-32 x 7/16
8X-888	3	Screw, Adjusting Bracket & Bridge Mtg., Fill. Hd. #8-32 x 5/16
VRH-3035B	1	Coil Assembly, Circuit Breaker
GAA-35B	1	Bushing, Insulating, Stationary Contact Bracket (.187 x .250 x 1/32)
VRA-15	1	Nut, Knurled, Adjusting, #10-48
VRA-16	1	Screw, Adjusting, #10-48 x 19/32
VRA-17	1	Spring, 16 Coils
VRH-23A	1	Insulation, Stationary Contact Bracket
VRH-35	1	Bracket, Resistor
VRH-37A	1	Bushing, Insulating, Stationary Contact Bracket (.187 x .250 x 3/32)
VRH-1073	1	Contact & Bracket, Stationary
VRY-1043A	1	Armature
12X-195	6	Lockwasher, Stationary Contact Bracket & Bridge Mtg., #8

Part No.	Qty.	Name of Part
8X-350	4	Washer, Plain, Stationary Contact Bracket & Bridge Mtg., #8
8X-878	3	Screw, Stationary Contact Bracket & Bridge Mtg., Fill. Hd. #8-32 x 7/16
8X-888	3	Screw, Stationary Contact Bracket & Bridge Mtg., Fill. Hd. #8-32 x 5/16
X-1465A	2	Washer, Insulating, Stationary Contact Bracket (11/64 x 3/8 x 1/32)
VRH-3071C	1	Coil Assembly, Voltage Regulator
VRA-15	1	Nut, Knurled, Adjusting, #10-48
VRA-16	1	Screw, Adjusting, #10-48 x 19/32" Lg.
VRA-84	1	Spring, 14 1/2 Coils
VRA-1060B	1	Bracket, Gap Adjusting
VRA-1080B	1	Armature
12X-195	6	Lockwasher, Adjusting Bracket & Bridge Mtg., #8
8X-350	4	Washer, Plain, Adjusting Bracket & Bridge Mtg., #8
8X-878	2	Screw, Bridge Mtg., Fill. Hd. #8-32 x 7/16" Lg.
8X-888	4	Screw, Adjusting Bracket & Bridge Mtg., Fill. Hd. #8-32 x 5/16" Lg.
VRP-100B	1	Resistor, Marked 60
VRP-100C	1	Resistor, Marked 15
VRP-100F	1	Resistor, Marked 80
8X-55	2	Screw, Resistor Mtg., Rd. Hd. #8-32 x 3/8" Lg.
8X-59	6	Screw, Resistor Mtg., Rd. Hd. #8-32 x 3/16" Lg.
X-163A	2	Nut, Cover Holding, Hex., 1/4-20
8X-173	1	Nut, Series Connection, Hex., #10-32
8X-183A	9	Washer, Plain, Lead Connection (2), Base Mtg., (6), Grd. Sc., (1), #10
X-187	4	Washer, Plain, Cover Holding, 1/4" Dia.
12X-195	8	Lockwasher, Resistor Mtg., #8
12X-196	10	Lockwasher, Lead Connection (3), Series Connection (1) Base Mtg., (6), #10
12X-199	5	Lockwasher, Cover Holding & Coil Mtg., 1/4" Dia.
8X-309	7	Screw, Lead Connection (1), Base Mtg. (6), Rd. Hd. #10-32 x 1/2" Lg.
8X-311	1	Screw, Lead Connection, Rd. Hd., #10-32 x 3/8" Lg.
8X-321	1	Screw, Lead Connection, Rd. Hd., #10-32 x 5/16" Lg.
8X-350	8	Washer, Plain, Resistor Mtg., #8
19X-453	2	Screw, Drive, Name Plate
8X-1055	3	Nut, Coil Mtg., Hex., 1/4-28


4 15/16
13/16 RELEASE
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6158
A5579A
5791
103-F
106-A
1968-A
119B-2
12 1/4
12" P.D.
11 1/2
7"
5"
1/4 x 1/8 K'YW'Y.
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1 1/2 TAPER PER FOOT.
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117C-8-S
2137
2245
115
1990
A-1069
6310J
A5223
M116
CUT 72 TEETH
6-8 P. 20° P.A.
M-642
M-641
M-645A
1395A
M945

USE CERTIFIED PRINT
FOR INSTALLATION.

FOR X-7751 & X-8249 P.T.O.

NAME C-11½ CLUTCH		LO	3-31-37
TWIN DISC CLUTCH CO. RACINE, WISCONSIN		X-7875	

Ⓐ WAS 7875 12-8-36 — *1406

SUPERCEDES *X 7875 OF 10-9-31

TWIN DISC CLUTCH
(Twin Disc Clutch Co.)

Model #C-111

Assembly #7875

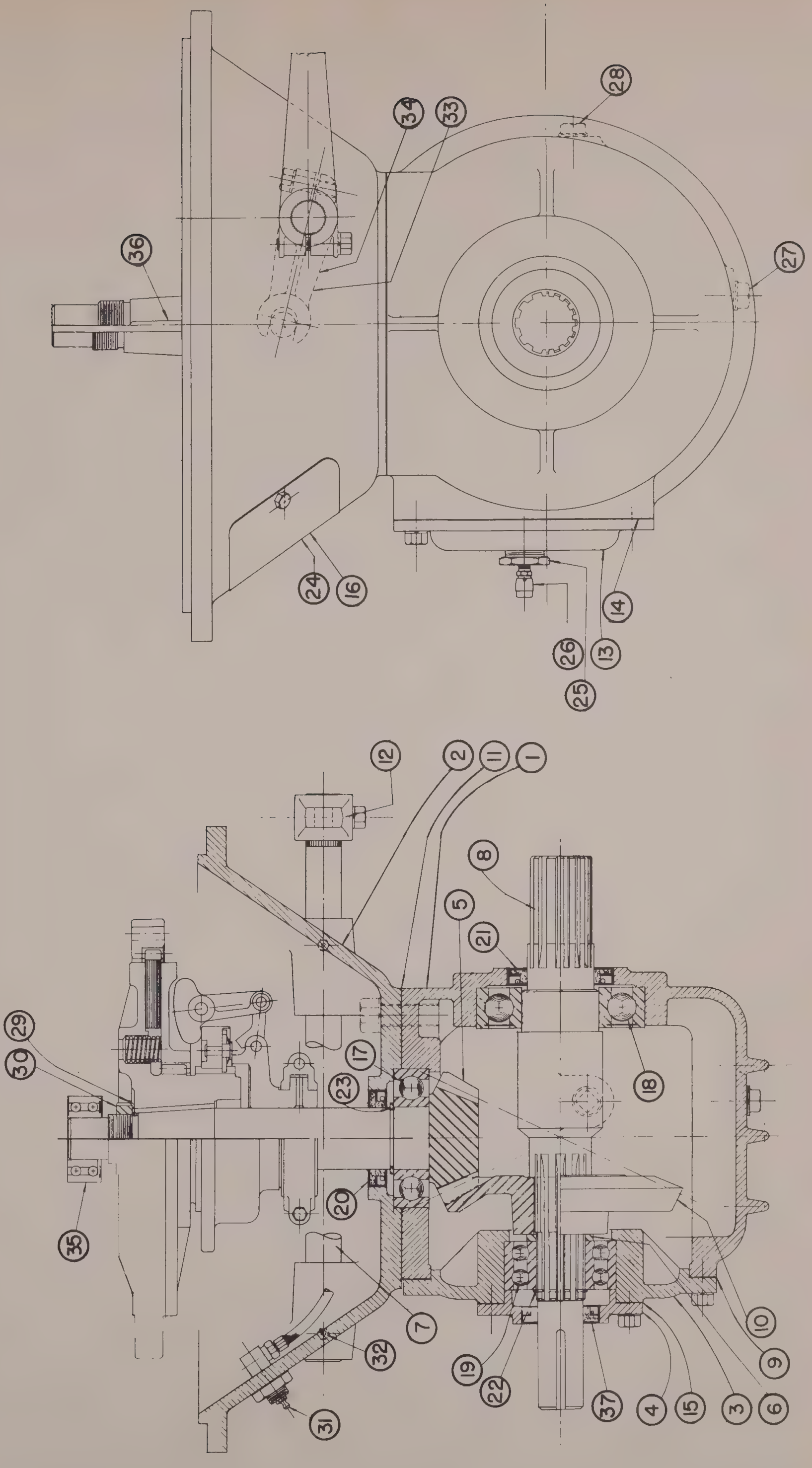
Part No.	Qty.	Name Of Part
6158	1	Hub & Back Plate - 1-3/4 Taper Bore
A-60	1	Adjusting Yoke Assembly (Consisting of)
1990	1	Adjusting Yoke
103F	4	Finger Levers
106A	4	Finger Pins
M641	4	Snap Rings
2245	1	Adjusting Lock Pin
115	1	Adjusting Lock Pin Spring
S-3	1	Sliding Sleeve Assembly (Consisting of)
2137	1	Sliding Sleeve Bore 1.756 - 1.754
119B2	8	Lever Links
1968A	8	Lever Link Pins
M642	8	Snap Rings
117C8	1	Cone Collar
M649	2	Bolts
M645	2	Nuts
120C8	2	Shims
A5579A	1	Driving Plate

MISCELLANEOUS PARTS

Part No.	Qty.	Name Of Part
5791	1	Floating Plate
A1069	6	Release Springs

Right Angle Power Take-Off Assembly

(See Reverse Side for Part Numbers and Description)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When Ordering Parts Always give Serial Number of Machine

WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

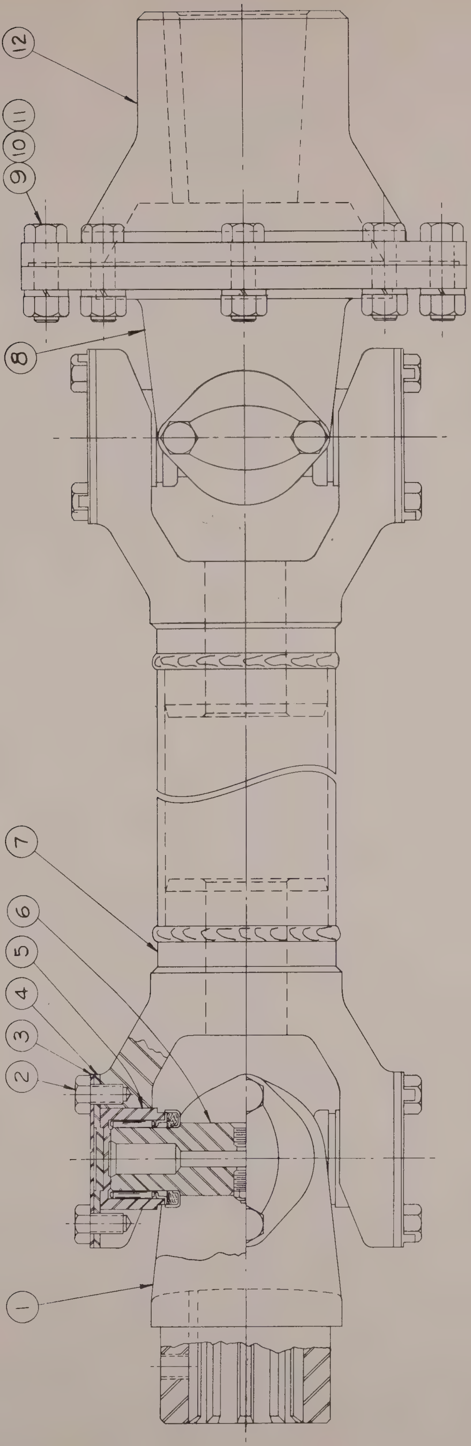
Right Angle Power Take-Off Assembly Complete RT501-B
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	RT501-1	1	Bevel Gear Housing
2	RT501-2	1	Bell Housing No. 3
	RT501-2A	1	Bell Housing No. 2
3	RT501-3	1	Housing Cover
4	RT501-5	1	Bearing Cover
5	RT501-6	1	Input Shaft-Rockford Clutch
	RT501-6A	1	Input Shaft-Twin Disc Clutch
6	RT501-8	1	Spacer
7	RT501-9	1	Clutch Shifter Shaft (Rockford)
	RT501-9A	1	Clutch Shifter Shaft (Twin Disc)
8	RT501-11	1	Output Shaft
9	RT404-12	1	Gasket
10	RT485-8	1	Spiral Bevel Gear
11	RT498-8	1	Gasket Bell Housing
12	66-2046A	1	Lever
13	RT3207	1	Housing Cover
14	MT1070	1	Gasket
15	G208	1	Gasket
16	RT1120	1	Gasket-Name Plate
17	#309	1	Ball Bearing
18	#311SF	1	Ball Bearing Single Shield
19	#5307	1	Ball Bearing
20	Nat'l 50183	1	Oil Seal
21	Nat'l 50298	1	Oil Seal
22		1	#7 Std. Snap Ring .062 Thick
23		1	#9 Std. Snap Ring .093 Thick
24		1	Name Plate
25		1	Pipe Bushing 3/4" to 1/8" Std.
26		1	Breather Alemite #G-131532
27		1	Pipe Plug 1/2" Magnetic
28		1	Pipe Plug 1/2" Std.
29		1	Lockwasher W-07 Std.
30		1	Locknut N-07 Std.
31		1	Grease Hose Assembly Std.
32		2	Alemite 1/8" Std. Straight #1610 Std.
33	UPT726	1	Clutch Throw Out (Rockford)
	1037	1	Clutch Throw Out (Twin Disc)
34		2	Woodruff Key #15 Std.
35		1	Ball-Bearing Pilot (See Power Plant Ass'y.)
36		1	Key Input Shaft (Rockford 3/8" Sq. x 2" Lg.)
		1	Key Input Shaft (Twin Disc 1/4" Sq. x 2 3/8" Lg.)
37	Nat'l 50165	1	Oil Seal

NOTE: #5 and #10 Furnished in Matched Sets Only

UNIVERSAL DRIVESHAFT ASSEMBLY

See Reverse Side for Part Numbers and Description



When Ordering Parts Always give Serial Number of Machine

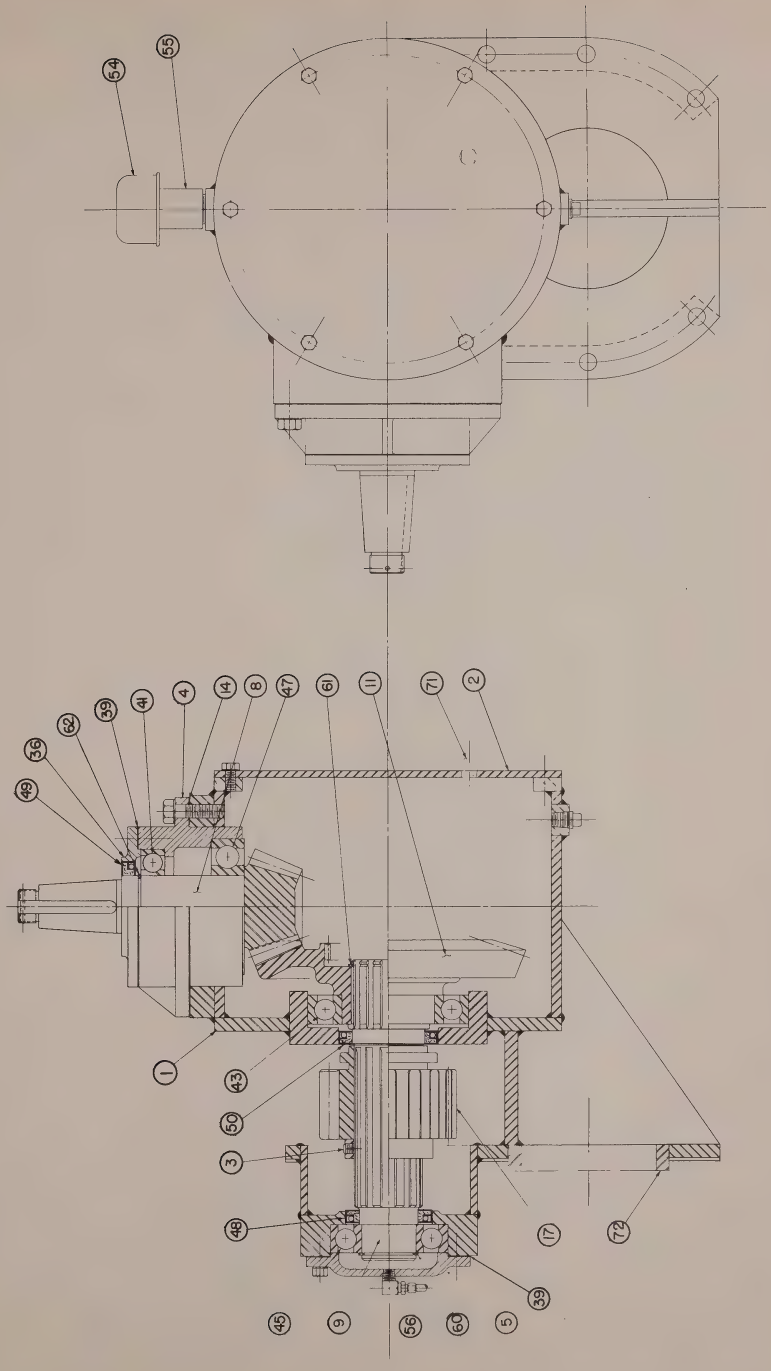
WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

Universal Driveshaft Assembly Complete #CR-2521C
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	5NYS28-54	1	Plain Yoke
2	5N7	16	Cap Screw
3	5N9	8	Lock Plate
4	5N81	8	Cover Plate
5	5N41A	8	Needle Cup Assembly
6	5N1A	2	Center Cross Assembly
7	SA-11094-1	1	Yoke Tube Assembly
8	5NF2	1	Flange Yoke
9		8	3/8"-24 N.F. Hex. Hd. Cap Scr. 1 1/4" Lg.
10		8	3/8"-24 N.F. Hex. Nut
11		8	3/8" Std. Lock Washer
12	3WCT32-11	1	Companion Flange

RIGHT ANGLE REDUCTION TRANSMISSION

See Reverse Side for Part Numbers and Description.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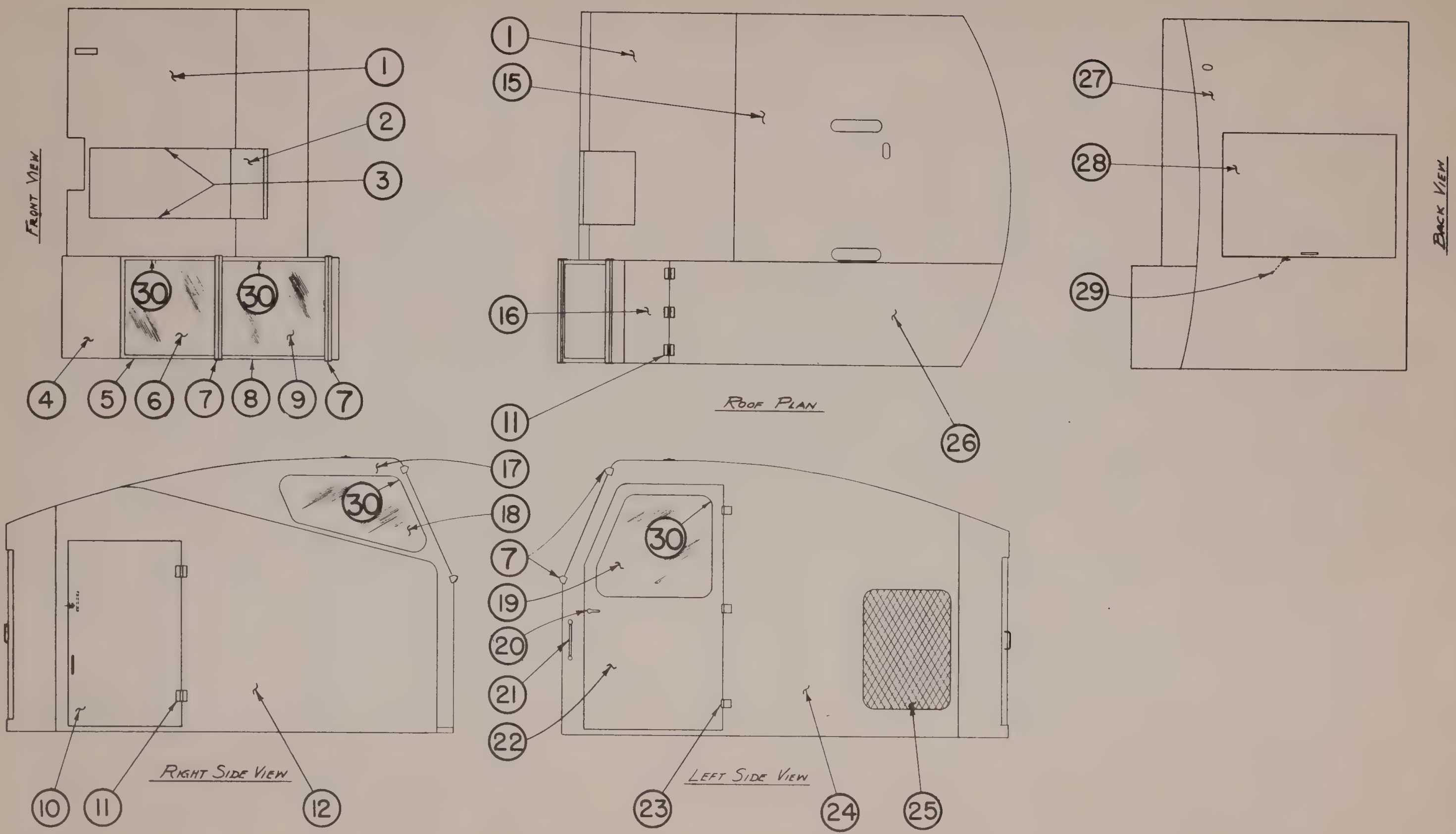
Right Angle Reduction Transmission - Complete RT-540

(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	RT-540-1	1	Housing
2	RT-540-2	1	Housing Cover
3	RT-540-3	1	Collar
4	RT-502-4	1	Cover Input
5	RT-502-5	1	Cover Patt. BC-212A
8	RT-502-13	1	Bevel Pinion Forg. BP-1227
9	RT-502-16	1	Shaft Output
11	RT-502-23	1	Bevel Gear Forg. RT-419
14	RT-502-32	1	Gasket Cover Input
17	RT-502-42	1	Sliding Gear-Drum Gear
36	BR-212	1	Cover Patt. BR-212
39	G-212	2	Gasket
41	ASD-1513	1	Ball-Bearing #212
43	ASD-1515	1	Ball-Bearing #217
45	ASD-1517	1	Ball-Bearing #310
47	ASD-1519	1	Ball-Bearing #312
48	ASD-1608	1	Oil Seal 2 1/8" x 3 3/16" x 1/2"
49	ASD-1609	1	Oil Seal 2 3/8" x 3 3/8" x 1/2"
50	ASD-1610	1	Oil Seal 2 5/8" x 3 5/8" x 1/2"
54		1	Filler & Breather Std.
55		1	Filler & Breather Extension Std.
56		1	Lubricating Hose Assembly Std.
60		1	Snap Ring #10 Std.
61		1	Snap Ring #14 Std.
62		1	Snap Ring #12 Std.
71		2	Pipe Plug 1/2" N.P.T. Std.
72	40-2627A	1	Pilot Ring

CAB ASSEMBLY

See Reverse Side for Part Numbers and Description


FRONT VIEW
ROOF PLAN
BACK VIEW
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LEFT SIDE VIEW
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When Ordering Parts Always Give Serial Number of Machine

WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

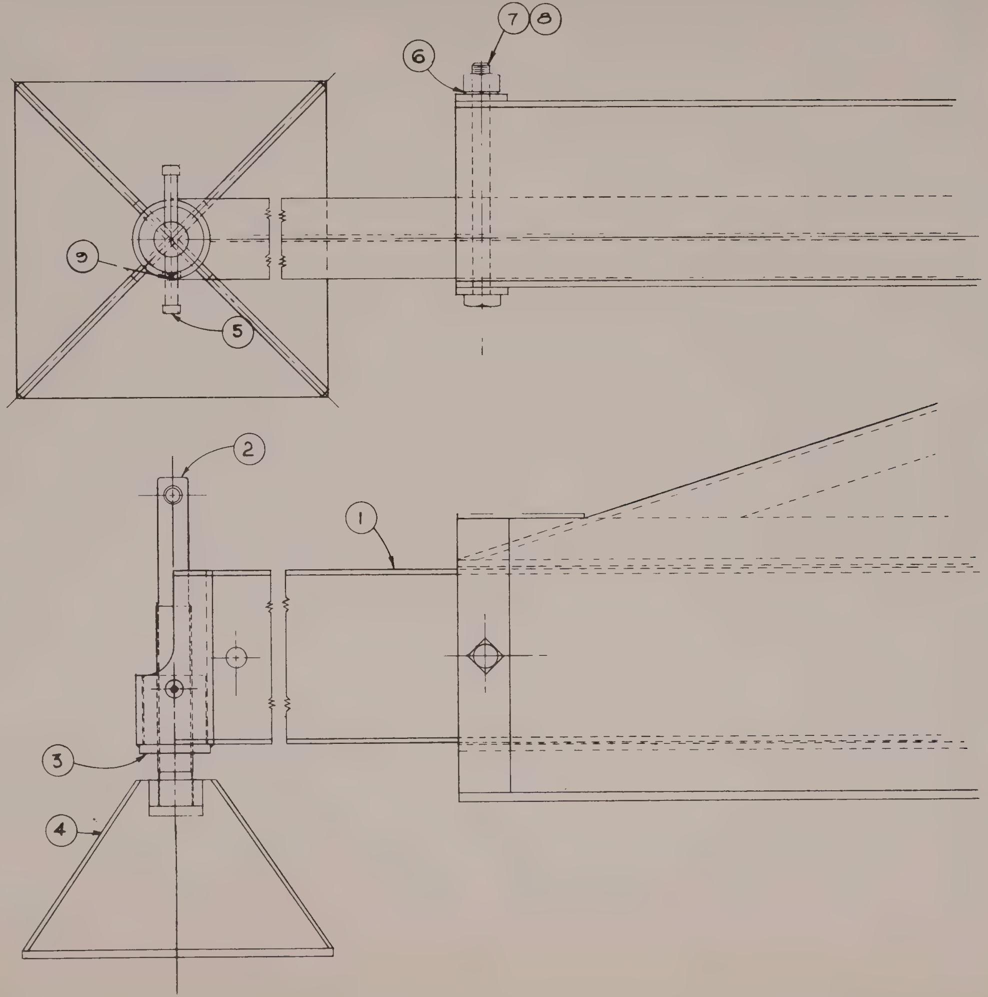
Cab Assembly Complete #66-2379D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	66-2375D	1	Front Section (FS2)
2	66-2376D	1	Front Panel (FP1)
3	66-2376D	2	Front Panel (FP2)
4	66-2374D	1	Front Section (FS1)
5	66-2377D	1	Window Frame (W2)
6	CR-2838A	1	Glass Install In Frame (W2)
7	66-2378C	2	Front Cab Braces (FB1)
8	66-2377D	1	Window Frame (W1)
9	CR-2837A	1	Glass Install In Frame (W1)
10	66-2376D	1	Hinged Door (D3)
11		5	3" x 3" Tight Pin Butt Hinges
12	66-2374D	1	Right Side Section (RS1)
15	66-2375D	1	Roof Section (RS3)
16	66-2377D	1	Hinged Door (D4)
17	66-2374D	1	Inside Section (FS1)
18	66-2377D	1	Glass Install In (FS1)
19	66-2377D	1	Glass Install In (D1)
20		1	Door Handle #R-10418
21		1	Body Handle #R-58211
22	66-2376D	1	Hinged Door (D1)
23		3	1 3/4" x 2" Blank Hinges
24	66-2373D	1	Left Side Section (LS1)
25		1	Expanded Metal Panel
26	66-2375D	1	Roof Section (RS2)
27	66-2373D	1	Back Section (BS1)
28	66-2376D	1	Sliding Door (D2)
29	66-2378C	1	Sliding Door Pin (DP1)
*30	See Note		Rubber Window Strip

*When Ordering Window Strip Specify Item No. of Glass Panel

OUTRIGGER ASSEMBLY

See Reverse Side for Part Numbers and Description



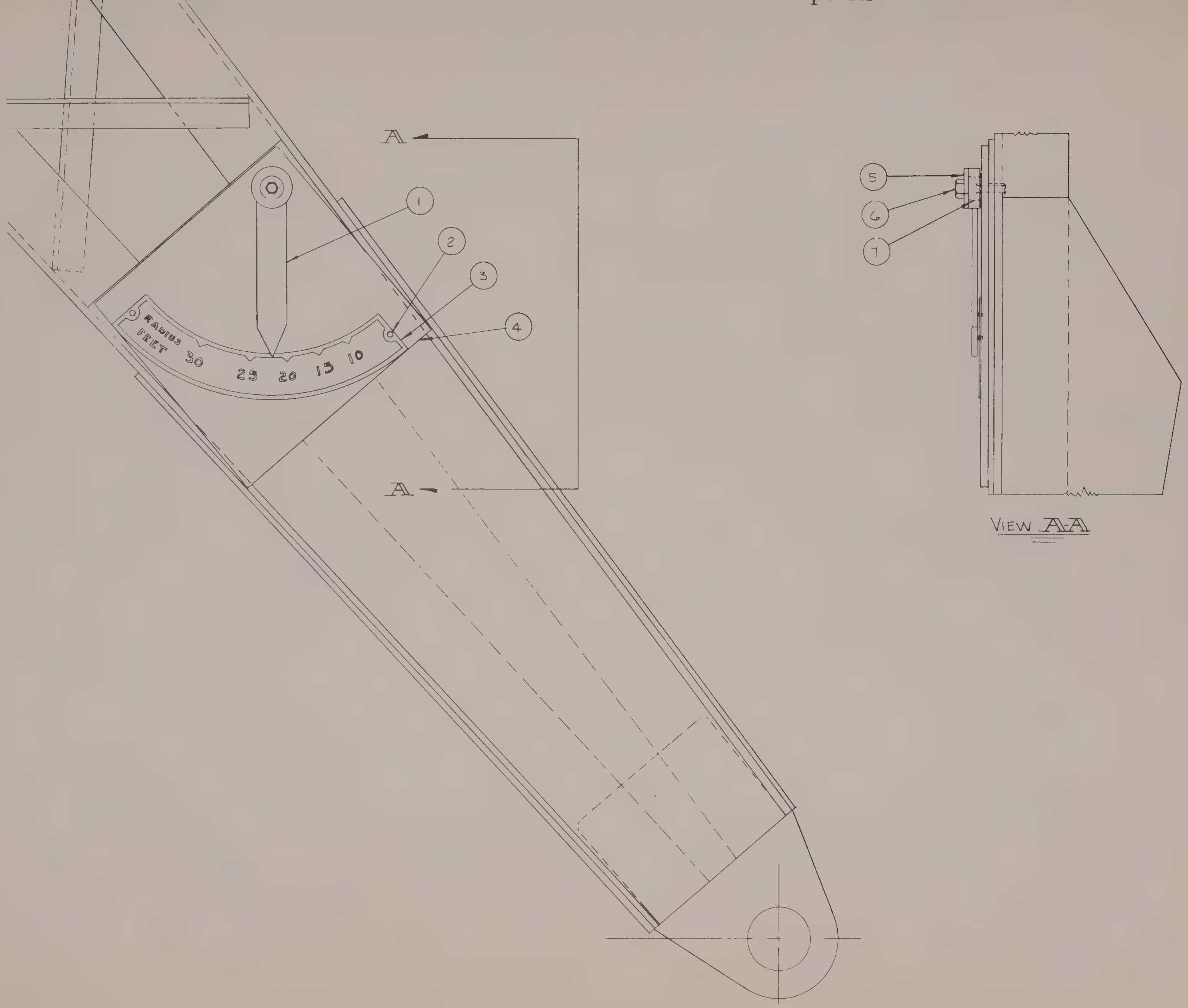
Outrigger Assembly Complete #CR-2650C
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	CR-2647B	4	Outrigger Beam
2	CR-2651A	4	Screw Jack
3	CR-2652A	4	Screw Jack Head
4	CR-2718B	4	Outrigger Float
5	SK-1591	4	Screw Jack Handle
6		4	1" Std. Lockwasher
*7		4	1"-8 N.C. Sq. Hd. Bolt 14 1/2" Lg.
8		4	1"-8 N.C. Sq. Hd. Nut
9		4	1/8" N.P.T. Alemite

*Length as specified used on 6 x 6 carriers. All others use 12" length.

RADIUS INDICATOR ASSEMBLY

See Reverse Side for Part Numbers and Description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RADIUS FEET
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VIEW A-A

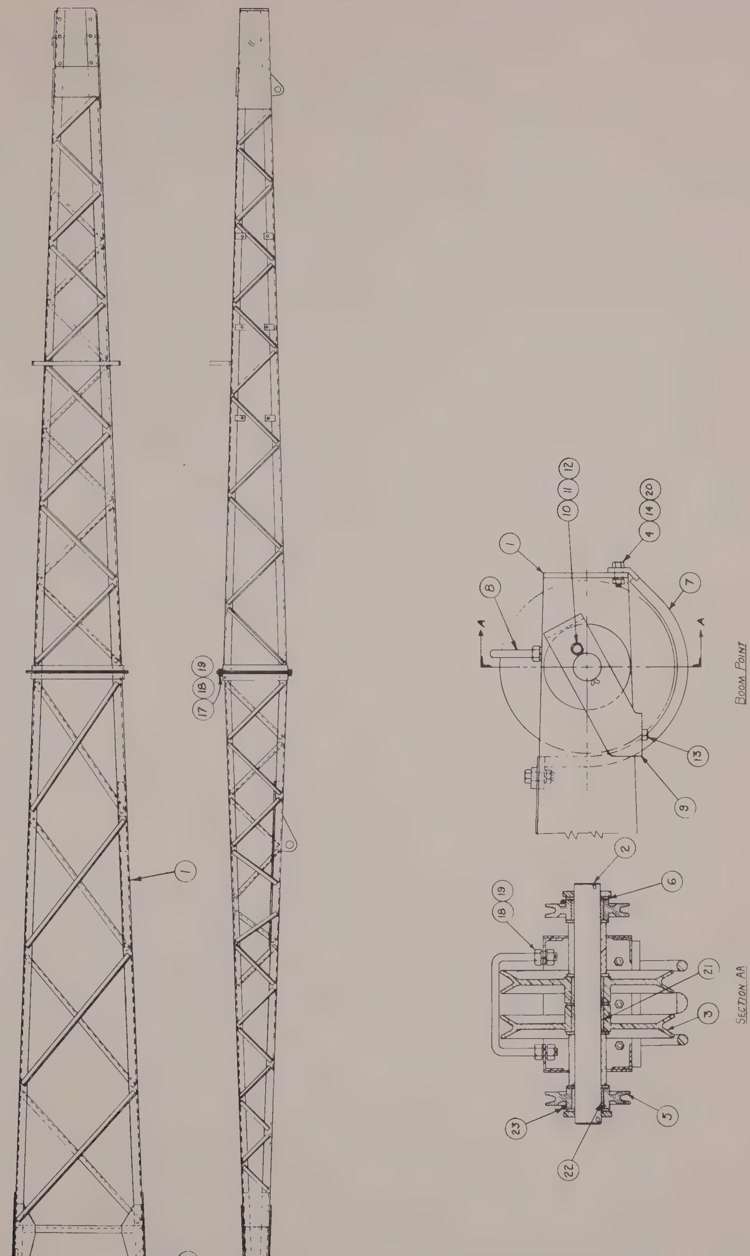
When Ordering Parts Always give Serial Number of Machine

Radius Indicator Assembly Complete #CR-2863C
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	CR-2701A	1	Radius Indicator
2		2	#6 x 1/4" Lg. Type "U"-Drive Scr.
3	CR-2862B	1	Radius Indicator Plt.
4	CR-2702A	1	Radius Indicator Base Plt.
5	CR-2700A	1	Washer (Radius Indicator)
6		1	5/16"-18 N.C. Hex. Hd. Cap Scr. x 1 3/8" Lg.
7	88038	1	New Departure Brg.

30'-0" BOOM AND BOOM POINT

See Reverse Side for Part Numbers and Description.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SECTION AA

When Ordering Parts Always Give Serial Number of Machine

30'-0" Boom Assembly - Complete 17-997D Type 4

(See Reverse Side for Illustration)

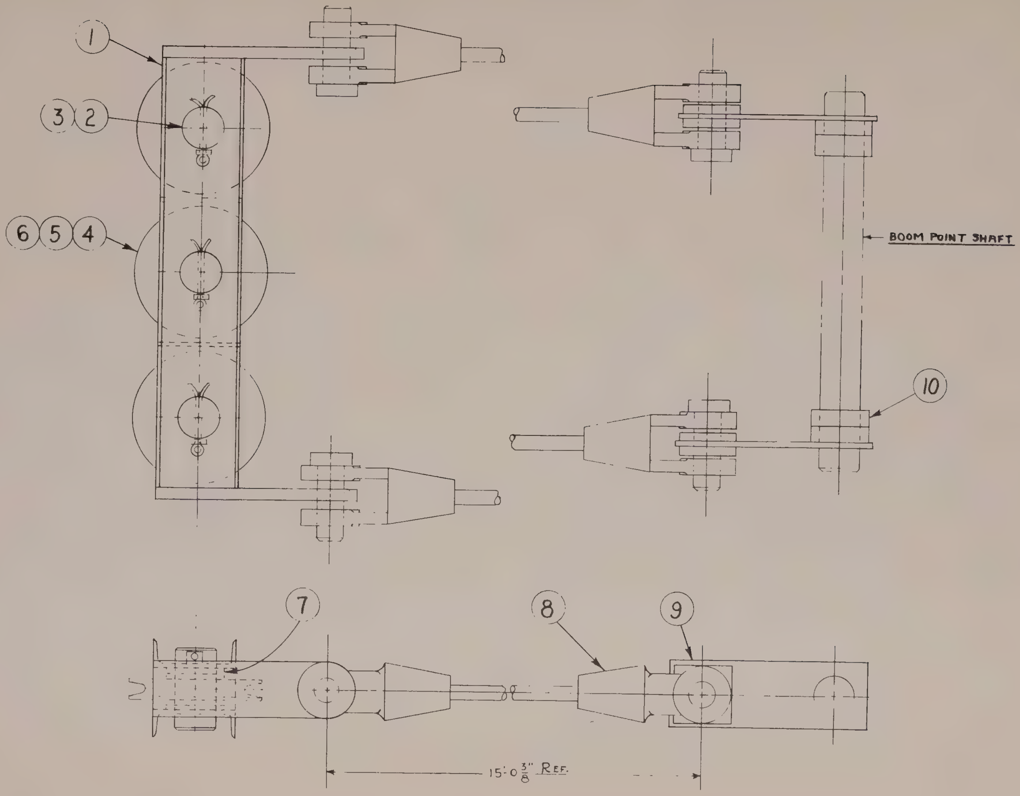
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	17-975D	1	30'-0" Boom
2	17-787	1	Shaft
3	17-977B	2	Sheave
4		6	5/8"-11 N.C. Hex Hd. Cap Scr. 2" Lg.
5	17-110B-2	2	Sheave
6	17-793A	7	Washer
7	17-1033B	1	Bottom Cable Guard
8	17-966A	1	Top Cable Guard
9	17-980A	2	Side Cable Guard
10		2	3/8" Cotter Pin 4" Lg.
11		2	3/8"-16 N.C. Hex Hd. Cap Scr. 1" Lg.
12		2	3/8" Lock Washer
13		2	1/2"-13 N.C. Sq. Hd. Bolt and Nut 1 3/4" Lg.
14		6	5/8"-11 N.C. Hex Nut
15	17-530AA	2	Boom Foot Pin
16		2	1/2" Cotter Pin 5" Lg.
17		12	3/4"-10 N.C. Hex Hd. Bolts 1 1/2" Lg.
18		16	3/4"-10 N.C. Hex Nut
19		16	3/4" Lock Washer
20		6	5/8" Lock Washer
21	17-792A-1	2	Bushing Bronze
22	17-792A-2	2	Bushing Bronze
23		4	Alemite #1610

NOTE: When Bridle is Used:
Omit Item 5. Item 6 Becomes 3 Required.

BRIDLE ASSEMBLY

See Reverse Side for Part Numbers and Description.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15'-0 3/8" REF.

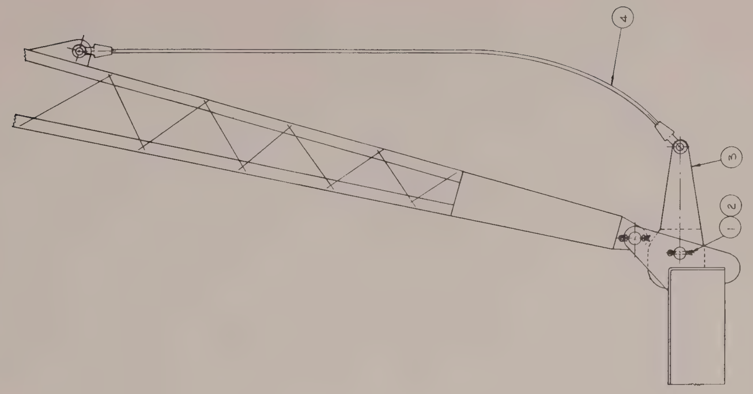
Bridle Assembly - Complete 17-994C

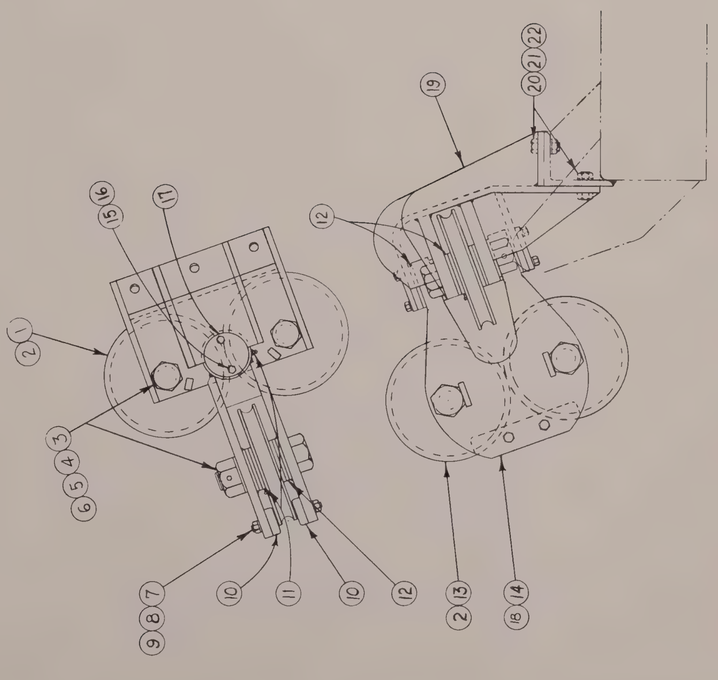
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	17-974B	1	Bridle Head Frame
2	ASD-1012-1	3	Pins
3		3	5/8" Cotter Pin 4" Lg.
4	17-110B-2	3	Sheave
5	17-792A-2	3	Bushing
6		3	Alemite #1610
7	17-793A	6	Washer - Brz.
8	17-878A	2	Bridle - Side Cable
9	17-876A	2	Bridle - Upper Side Arm
10	17-883A	2	Boom Point Spacer

CABLE BOOM SNUBBER - STYLE 2

See Reverse Side for Part Numbers and Description

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When Ordering Parts Always Give Serial Number of Machine

WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

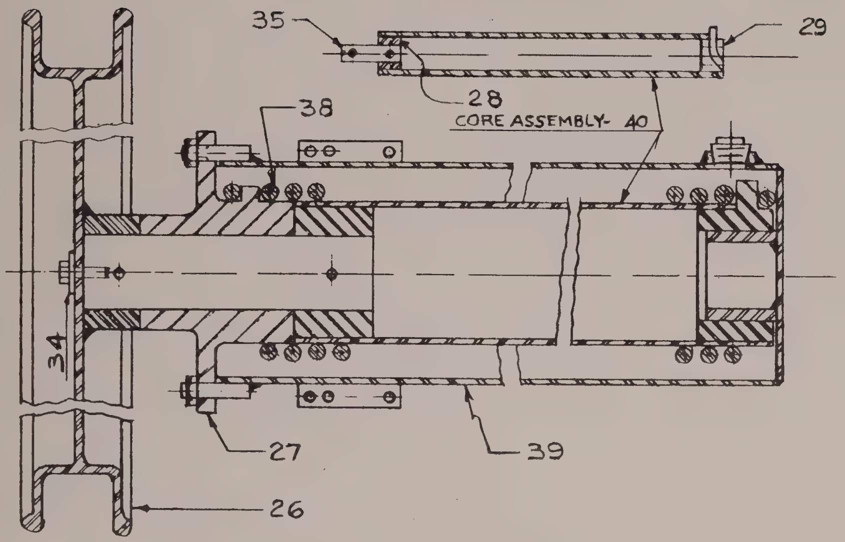
Fairlead Assembly Complete #66-2581D
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	17-173-1	2	Sheave
2	ASD-1028-1	4	Bushing Bronze
3		4	1 1/2"-6 N.C. Hex Hd. Bolt 6 1/2" Lg.
4		4	1 1/2"-6 N.C. Hex Nut
5		4	1 1/2" Std. Washer
6		4	3/8" Cotter Pin
7		4	1/2"-13 N.C. Hex Hd. Bolt 1 3/4" Lg.
8		4	1/2"-13 N.C. Hex Nut
9		4	1/2" Lockwasher
10	17-176	2	Wear Plate
11		6	1/8" Alemite #1610
12	17-058C	12	Washer Bronze
13	17-173	2	Sheave
14	17-175-3	1	Fairlead Arm
15		4	3/8"-16 N.C. Hex Hd. Cap Screw 7/8" Lg.
16		4	3/8" Lockwasher
17	66-2263A	2	Fairlead Arm Pin
18	ASD-1028-2	2	Bushing Bronze
19	66-2262D	1	Fairlead Frame
20		6	1"-8 N.C. Hex Hd. Bolt 2 1/2" Lg.
21		6	1"-8 N.C. Hex Nut
22		6	1" Lockwasher

Cable Boom Snubber Assembly Complete #17-1032C
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	ASD-1010-2	2	2" Dia. Pin
2		4	1/2" Dia. Cotter Pin 3" Lg.
3	17-1031B	2	Snubber Arm - 1 R.H. - 1 L.H.
4	17-1030A	1	Snubber Cable

See Reverse Side for Illustration.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CORE ASSEMBLY- 40
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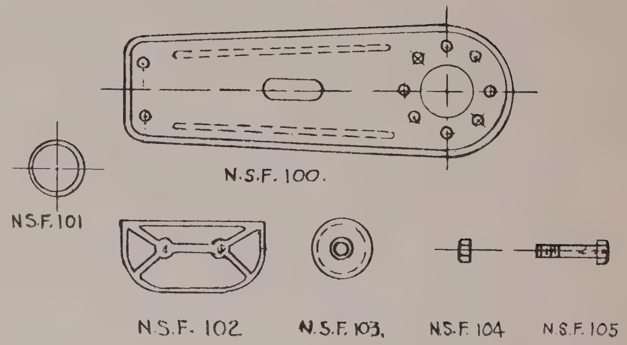
— GENERAL ARRANGEMENT —

26 - WHEEL
27 - BEARING
28 - BUSHING
29 - PROPELLER
34 - SAFETY PLATE
35 - SHAFT
38 - SPRING
39 - HOUSING
40 - CORE ASSEMBLY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N.S.F. 102
N.S.F. 103.
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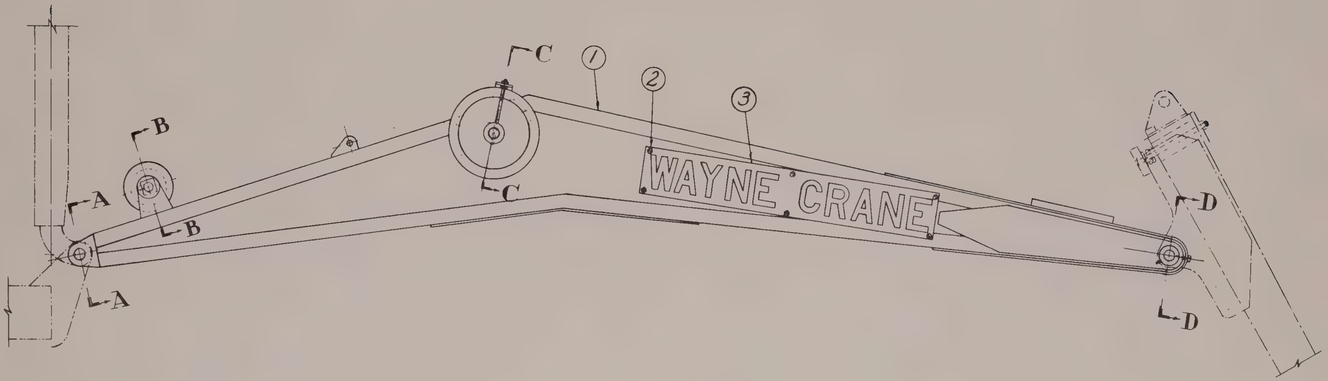
N.S.F. 105

— NEW STYLE FAIRLEAD —

N S F. 100 - FAIRLEAD ARM
N S.F. 101 - HEAD BEARING GASKET
N S F 102 - CABLE GUIDE
N S F 103 - SHEAVE
N. S F 104 - SHEAVE PIN NUT
N. S. F. 105 - SHEAVE PIN

BOOM ASSEMBLY FOR TRENCH HOE
TYPE-10

(See Reverse Side for Part Numbers and Description)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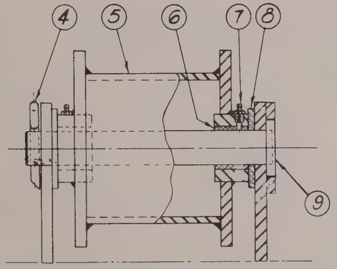
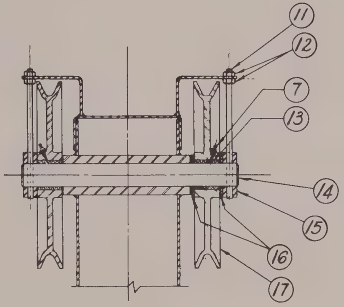


Sect."B B"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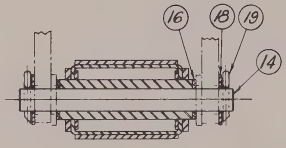
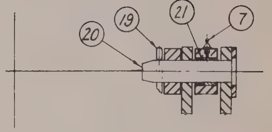


Sect."D-D"



Sect."A-A"

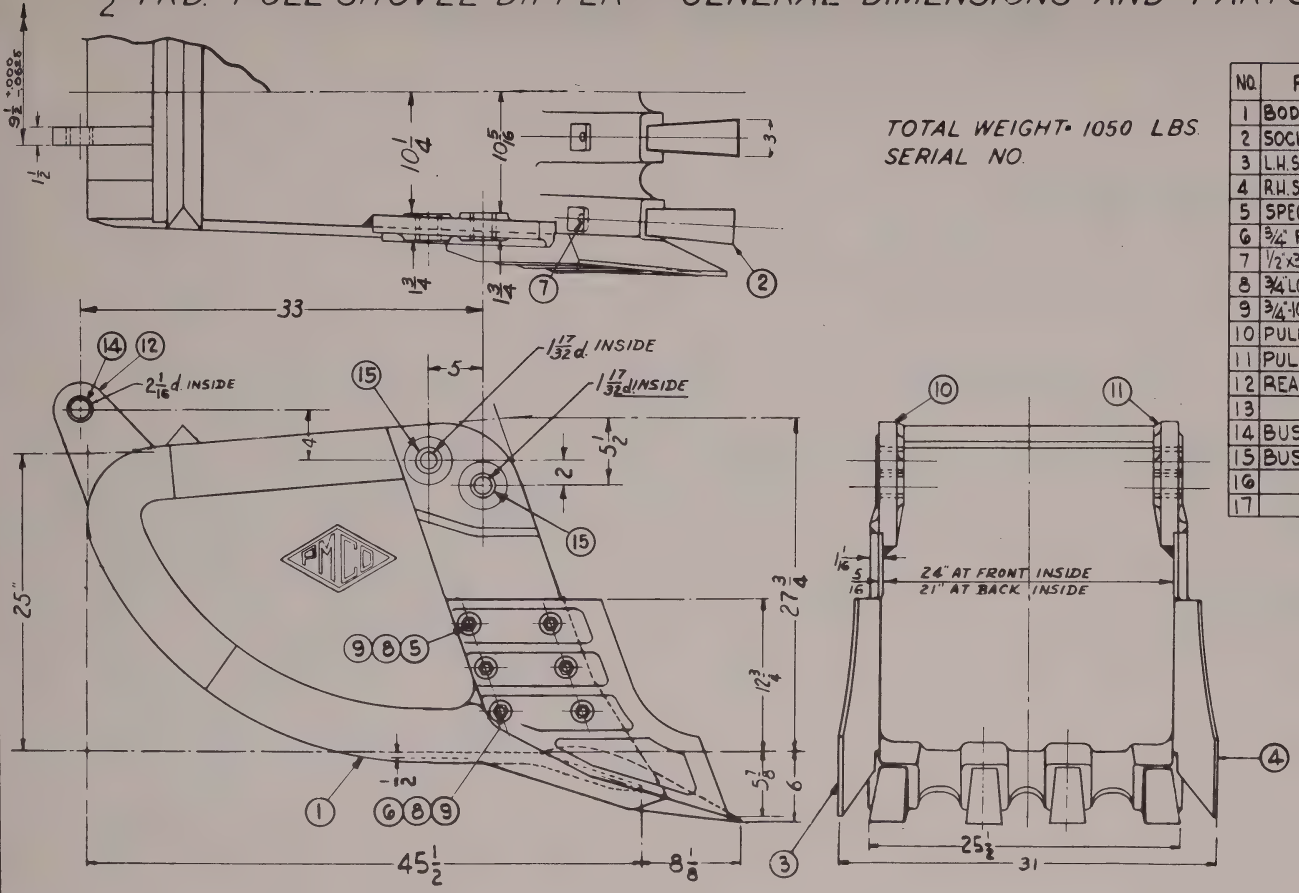
Boom Assembly for Trench Hoe Complete #17-1028D
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	17-1022D	1	Boom
2		12	5/16"-18 N.C. Hex Hd. Cap Scr. 1/2" Lg. and Lockwasher
3	17-295	2	Wayne Crane Nameplate
4		1	3/8" Cotter Pin x 2 1/2" Lg.
5	17-1027A	1	Boom Roller
6	ASD-1023-1	2	Bronze Bushing
7		6	1/8" N.P.T. Alemite #1610
8	17-058C	2	Bronze Washer
9	17-1026A	1	Boom Roller Shaft
10		4	3/8"-16 N.C. Dog Pt. Soc. Set Screw 3/4" Lg.
11	17-1054A	2	1/2" Dia. Bar - 11 3/4" Lg.
12		4	1/2"-13 N.C. Hex Nut
13	17-246G	2	Bronze Bushing
14	17-1053A	2	2" Dia. Shaft
15	17-1055A	2	1 1/4" Plate x 4" O.D.
16	17-058J	4	4" O.D. Brz. Washer
17	17-171B2	2	16 1/2" Dia. Sheave
18		2	2" Std. Flat Washer - 4 1/2" x 2 1/8" x 3/16"
19		4	1/2" Dia. Cotter Pin - 3" Lg.
20	17-1049A	2	Boom Foot Pin
21	17-246J	2	Bronze Bushing

$\frac{1}{2}$ YRD. PULL SHOVEL DIPPER — GENERAL DIMENSIONS AND PARTS LIST

TOTAL WEIGHT• 1050 LBS.
SERIAL NO.

NO.	PART	PART NO.	REQ.
1	BODY ASSEM.	A-1744	1
2	SOCKET POINT	730-8	4
3	L.H. SIDE CUTTER	002C104A1	1
4	R.H. SIDE CUTTER	002C104B1	1
5	SPECIAL ¾" BOLT	F-4290-9	8
6	¾" PLOW BOLT	650-0015	4
7	½"x3 COTTER PIN		4
8	¾" LOCKWASHER		12
9	¾"-10 HEX. NUT		12
10	PULL LUG L.H.	004C106AQ	1
11	PULL LUG R.H.	004C106AR	1
12	REAR LUG	L-2672	2
13			
14	BUSHING	L-2616-15	2
15	BUSHING	L-2616-1	4
16			
17			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$1\frac{17}{32}$d. INSIDE
$1\frac{17}{32}$d. INSIDE
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⑪
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$\frac{5}{16}$
24" AT FRONT INSIDE
21" AT BACK INSIDE
④
$25\frac{1}{2}$
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BILL OF MAT'L. NO. X-1174

FOR AMERICAN STEEL DREDGE CO. - MODEL:

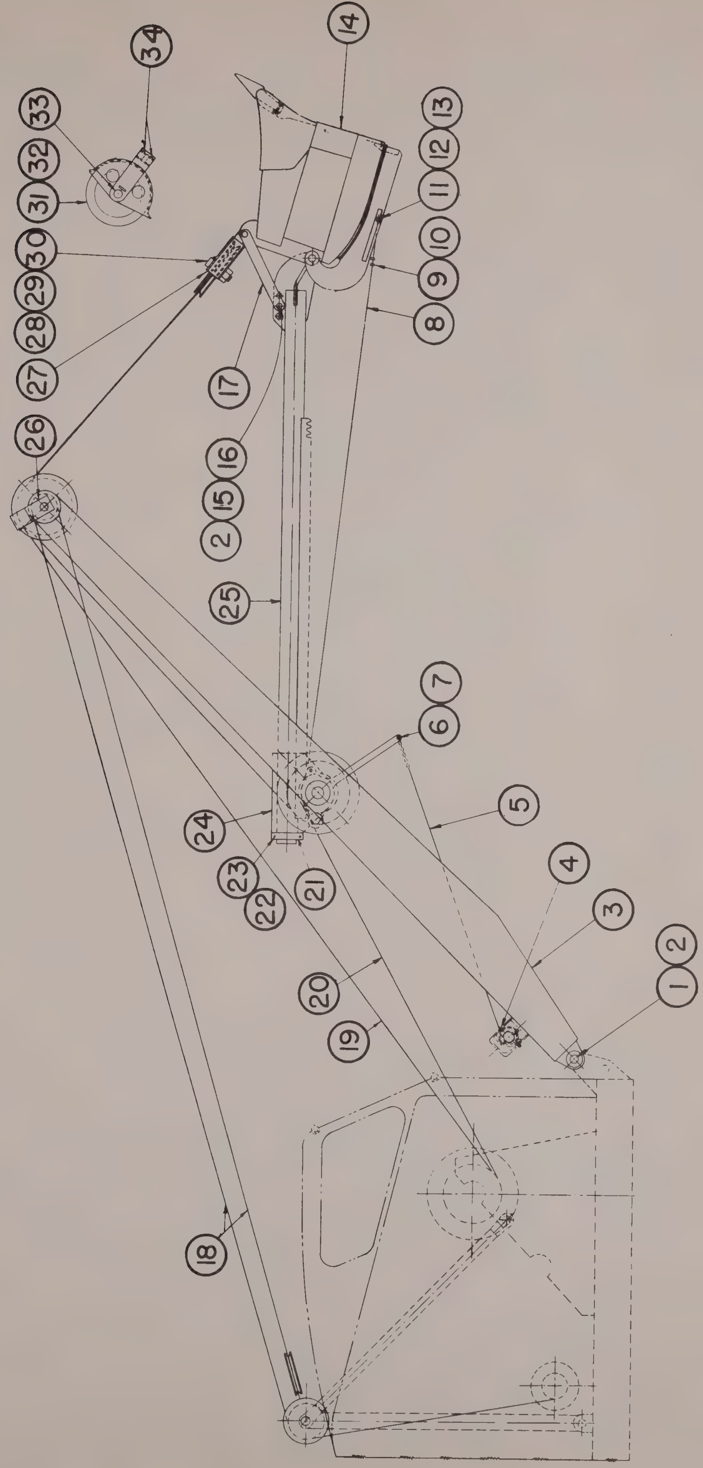
PETTIBONE MULLIKEN CORP.

CHICAGO, ILL.

F-7489

SHOVEL ASSEMBLY

See Reverse Side for Part Numbers and Description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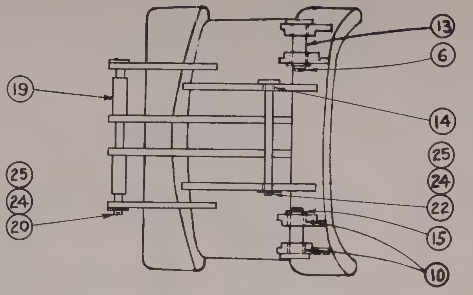
When Ordering Parts Always give Serial Number of Machine

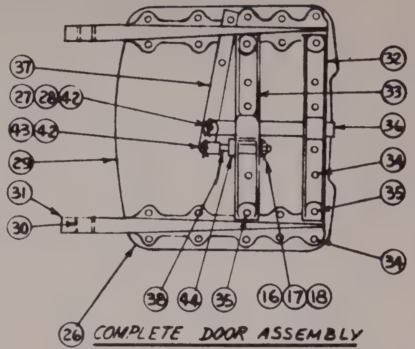
WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

Shovel Assembly Complete #17-973D
(See Reverse Side for Illustration)
Assembly Consists of:

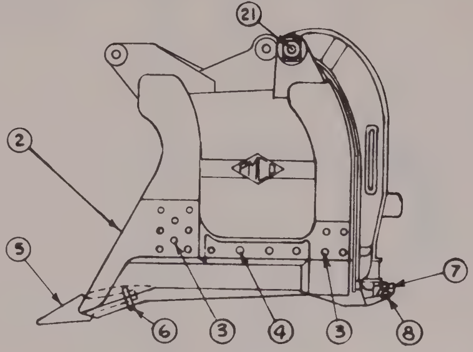
Item	Part No.	Qty.	Name of Part
1	17-530AA	2	Boom Foot Pin
2		3	3/8" x 3" Lg. Cotter Pin
3	17-770DA	1	Single Purpose Boom
4	17-625B	1	Electric Dipper Trip Assembly
5		1	1/4" Tiller Cable 11'-4" Lg.
6		1	1/4" Cable Clamp
7		1	1/4" Cable Thimble
8		1	3/8" Steel Cable 14' Lg.
9		2	3/8" Cable Clamp
10		1	3/8" Cable Thimble
11	SK-1463-1	1	Lever Shackle
12		1	1/2" Clevis Pin
13		1	5/32" x 7/8" Lg. Cotter Pin
14	PM-F-7492	1	Dipper Assembly
15		1	1-1/2"-6 N.C. Hex. Hd. Bolt 5-1/2" Lg.
16		1	1-1/2"-6 N.C. Hex. Nut
17	17-538D-K	2	Rake Brace
18		1	1/2" Steel Cable 116' Lg.
19		1	5/8" Steel Cable 88' Lg. (Hoist & Crowd)
20		1	5/8" Steel Cable 50' Lg. (Retract)
21	17-566B	1	Collar
22		2	3/4"-10 N.C. Sq. Hd. Bolt 4-1/2" Lg.
23		2	3/4"-10 N.C. Hex. Nut
24	17-963C	1	See Dipper Shaft Assembly
25	17-668D	1	Dipper Handle
26	17-964B	1	See Boom Point Shaft Assembly
27	17-303-1	1	Dipper Padlock Sheave
28	17-555	1	Pin
29		1	2" - 4-1/2 N.C. Hex. Nut
30		1	1/2" x 3-3/4" Lg. Cotter Pin
31	17-171B	1	16-1/2" O.D. Sheave
32	17-246G	1	2" x 2-1/2" x 2-1/4" Lg. Bronze Bushing
33	17-058P	2	2" I.D. x 4" O.D. x 7/32" Brz. Washer
34	ASD-1023-1	2	1-1/2" x 1-7/8" x 1-1/2" Brz. Bushing

ITEM	PART NAME	PART NUMBER	NO. REQ.	WEIGHT EACH
1				
2	FRONT	A-798-C	1	
3	CONE HD. RIVET 5/8"x3 1/2"	STD.	24	
4	CONE HD. RIVET 5/8"x2 3/4"	STD.	8	
5	POINT	730-8M	4	
6	KEY-1/2"x3" COTTER PIN	STD.	6	
7	LATCH KEEPER INSERT	F-3985	1	
8	LIVERPOOL RIVET 3/4"x3 1/4"	STD.	2	
9				
10	BUSHING	L-76-39	4	
11				
12				
13	HINGE PIN (SH. 148)	148-6	2	
14	BUSHING (L-75)	L-75-19	2	
15	2" WROUGHT WASHER	STD	2	
16	LOCKWASHER 1"	STD.	1	
17	1/4"x2 1/2" COTTER PIN	STD.	1	
18	1"-8 HEAVY SLOTTED HEX. NUT	STD.	1	
19	SPACER (L-2254)	L-2254-22	2	
20	BRACE & PADLOCK PIN (L-108)	L-108-18	1	
21	ALEMITE FITTING # 1627		2	
22	STICK PIN (L 108)	L-108-19	1	
23			2	
24	1 1/2" WROUGHT WASHER		2	
25	3/8 d x 2 1/4 COTTER PIN		2	
26	COMPLETE DOOR ASSEMBLY	B-3497	1	
27	PIN (L-119)	PC-985	1	
28	FLAT WASHER 3/4"	STD.	2	
29	DOOR PLATE	B-3137A	1	
30	HINGE BUSHING	L-29-3	2	
31	HINGE	004A120B	2	
32	FRONT LATCH BAR GUIDE	004A125C	1	
33	REAR LATCH BAR GUIDE	004A125D	1	
34	BUTTON HD. RIVET 5/8"x2 1/4	STD.	20	
35	BUTTON HD. RIVET 5/8"x2 3/4	STD.	4	
36	LATCH BAR	006A136A	1	
37	LATCH LEVER (SH. 73-1)	PC-986-1	1	
38	LATCH LEVER PIVOT	F-3977C	1	
39				
40				
41				
42	COTTER PIN 1/4"x1 1/2"	STD.	2	
43	LEVER PIN	L-119-6	1	
44	CLAMP NUT	L-221	1	
45				





COMPLETE DOOR ASSEMBLY



SIZE 1/2 YARD TOTAL WT. 1125 LBS.

DIPPER SERIAL NO.

GENERAL DIMENSIONS INSIDE

HEIGHT AT FRONT	26 IN.
HEIGHT AT REAR	27 1/2 IN.
WIDTH AT FRONT	30 1/2 IN.
WIDTH AT REAR	31 1/2 IN.
LENGTH AT BACK	26 IN.
LENGTH AT BOTTOM TO CUTTING EDGE	34 1/2 IN.

ASSEMBLY DWG. NO. A-1905

IN ORDERING PARTS GIVE

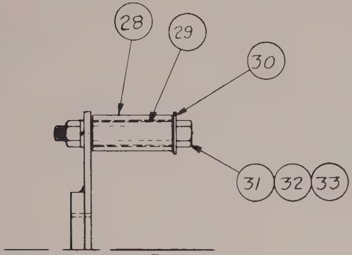
A. DIPPER SIZE
B. DIPPER SERIAL NUMBER ON SIDE OF DIPPER
C. NAME OF PART AS LISTED & PART NO.

PETTIBONE MULLIKEN CORPORATION
4710 W DIVISION STREET CHICAGO, ILL.
PARTS LIST AND SPECIFICATIONS
SHOVEL DIPPERS

APPROVED
DATE 4-16-51
F-7492

Shovel Shipper Shaft Assembly (Single Purpose Boom) Style #2

See Reverse Side for Part Numbers and Description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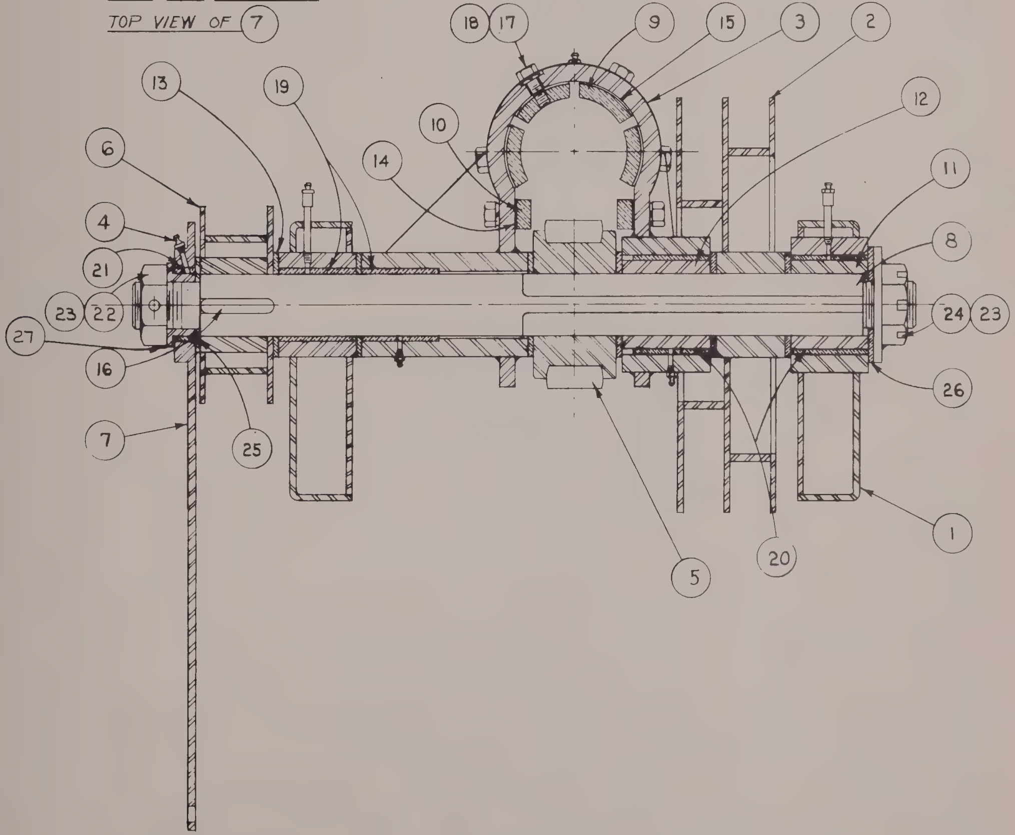
TOP VIEW OF ⑦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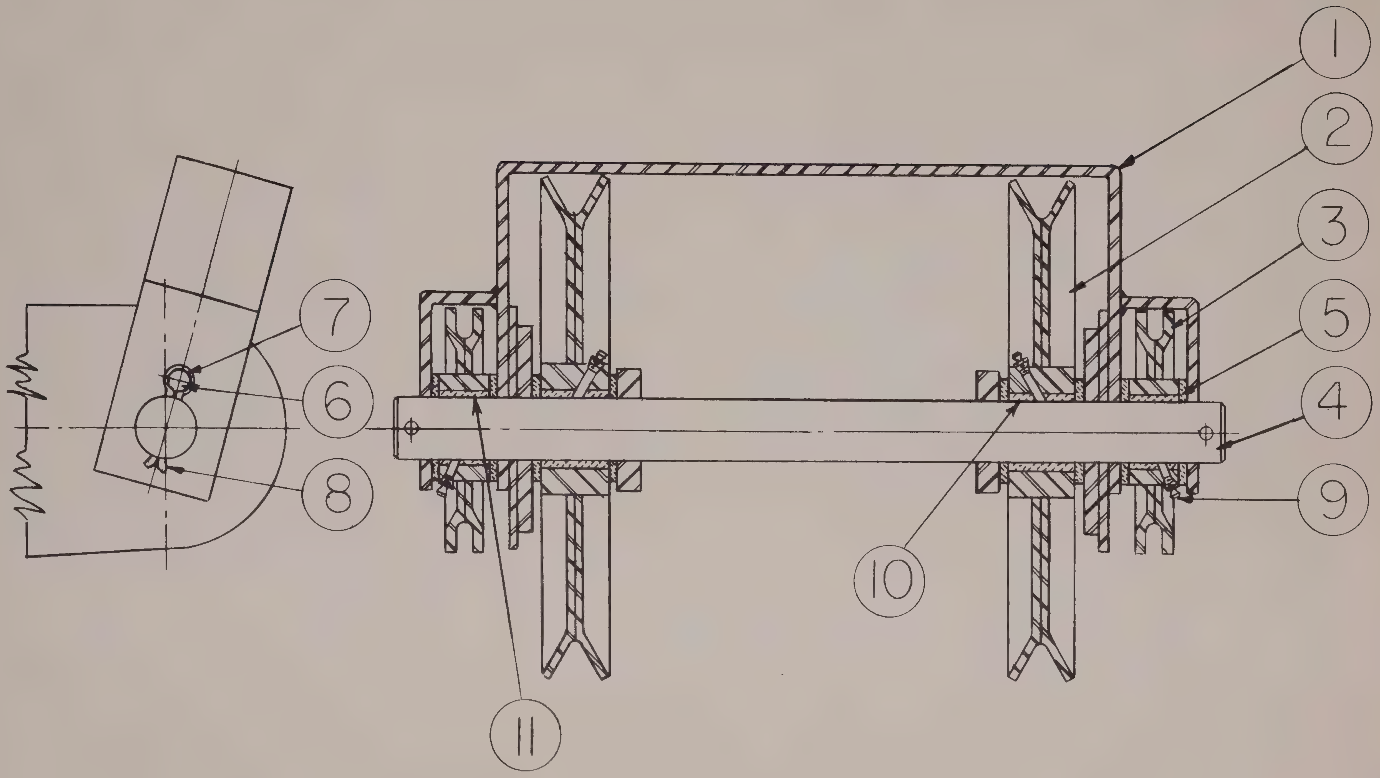
Shipper Shaft Assembly Single Purpose Style #2 Complete #17-963C
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	17-770DA	1	Shovel Boom
2	17-989C	1	Crowding Drum
3	17-9846	1	Saddle Block
4		5	Alemite #1610
5	17-567-1C	1	Pinion
6	17-301-1A	1	Trip Drum
7	17-623B	1	Trip Lever
8	17-983C	1	Shaft
9	17-559A	8	Guide Bar
10	17-559B	4	Guide Bar
11	17-753A	1	Spacer
12	17-753C	1	Spacer
13	17-754A	6	Washer - Bronze
14	17-583A	16	Shim
15	17-584A	24	Shim
16		1	3/4" x 3/4" Rd. End Key x 3 1/2" Lg.
17		24	5/8"-11 N. C. Hex Hd. Cap Screw 1 1/2" Lg.
18		24	5/8" Std. Lockwasher
19	ASD-1032-1	2	Bronze Bushing
20	17-699B	2	Bronze Bushing
21	17-663A	1	Bronze Bushing
22	17-986A	1	Nut
23		2	3/8" Dia. Cotter Pin 4 1/2" Lg.
24	17-987A	1	Nut
25		1	2" Std. Plain Washer
26	17-985A	1	Washer - Bronze
27	17-988A	1	Sleeve
28	SK-1488	1	Roller
29	17-996A	1	Roller Sleeve
30		1	3/4" Plain Washer
31		1	3/4"-10 N. C. Hex Hd. Bolt 5 1/2" Lg.
32		1	3/4"-10 N. C. Hex Nut
33		1	3/4" Lockwasher

BOOM POINT SHAFT ASSEMBLY

(See Reverse Side for Part Numbers and Description)



When Ordering Parts Always give Serial Number of Machine

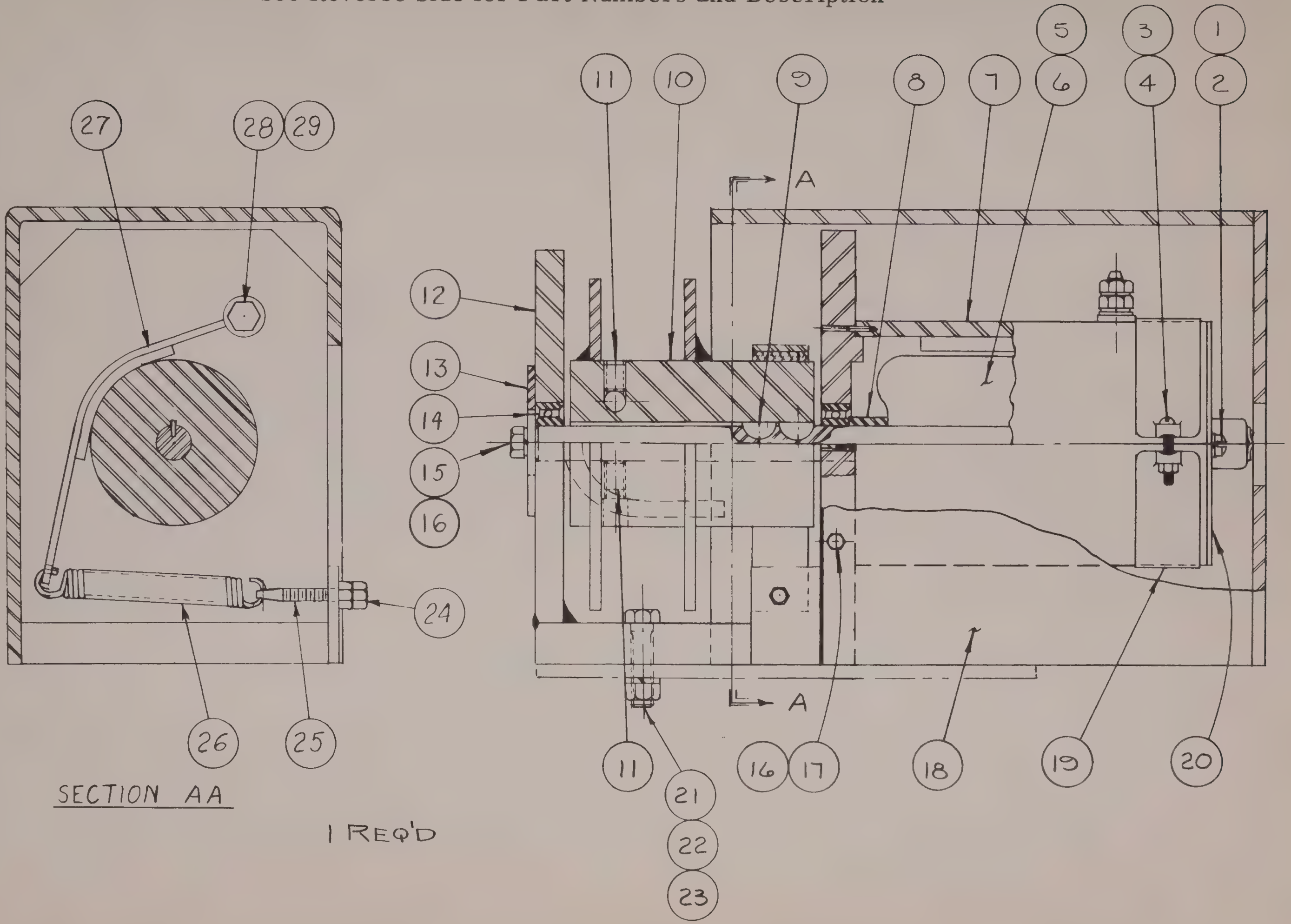
WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

Boom Point Shaft Assembly Complete #17-964B
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	17-770DA	1	Shovel Boom
2	17-171-1B	2	Sheave
3	17-110B-3	2	Sheave
4	17-706A	1	Shaft
5	17-058-B	8	Bronze Washer
6		2	3/8"-16 N.C. Hex Hd. Cap Screw 1" Lg.
7		2	3/8" Std. Lockwasher
8		2	1/2" x 3" Cotter
9		4	#1610 Alemite
10	17-246C	2	2 1/2" x 2" I.D. Bronze Bushing 2 1/4" Lg.
11	17-590A	2	2 3/8" x 2" I.D. Bronze Bushing 1 5/8" Lg.

ELECTRIC DIPPER TRIP ASSEMBLY

See Reverse Side for Part Numbers and Description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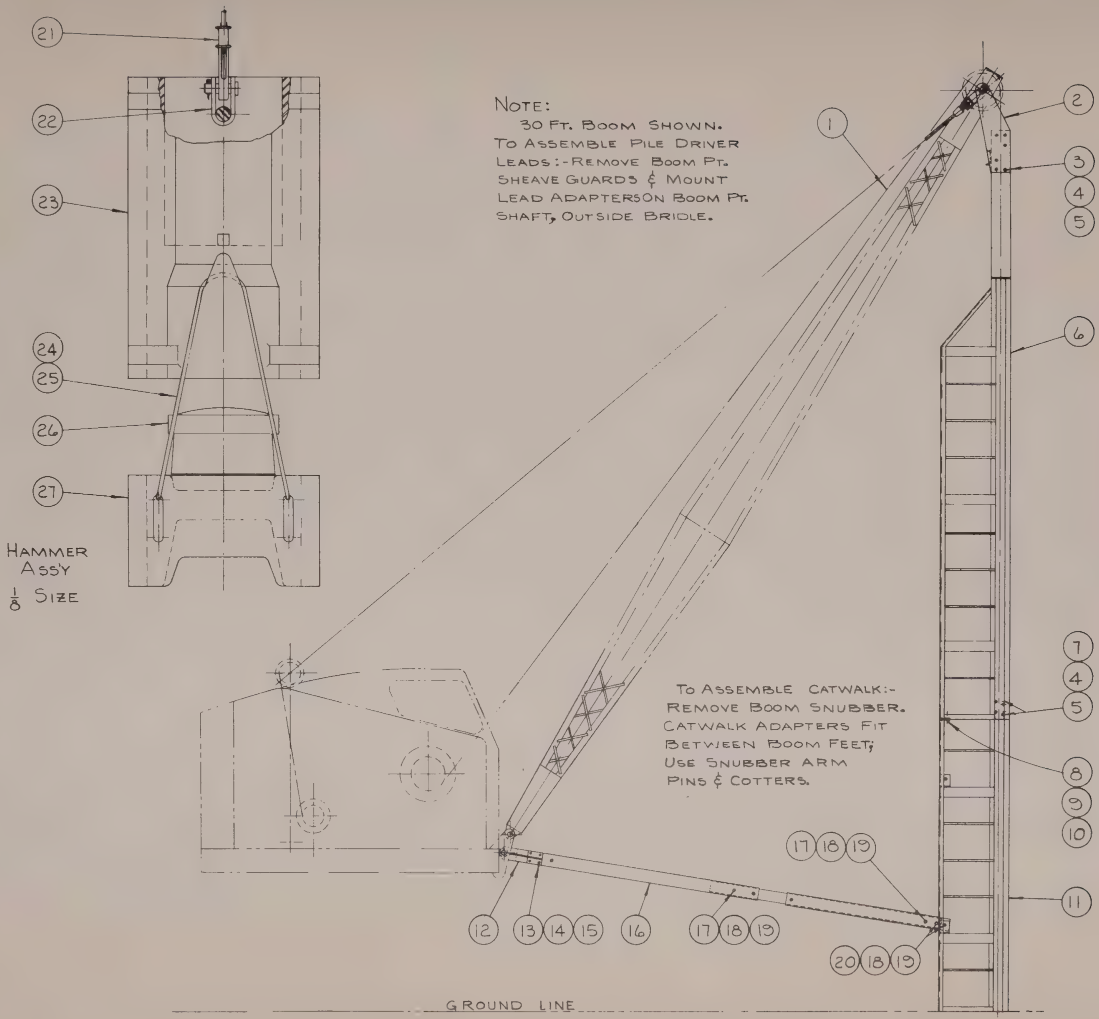
SECTION AA
1 REQ'D

Electric Dipper Trip Assembly Complete #17-625B
(See Reverse Side for Illustration)
Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1	GT-20-A	2	Assembly Thru Bolts - Elect. Auto-Lite
2	GT-20-A	2	Assembly Bolt Lockwasher
3		1	#10-24 N.C. Rd. Hd. Mach. Scr. x 1" Lg.
4		1	#10-24 N.C. Hex. Nut
5	MAB#2133	1	Armature Assembly - Elect. Auto-Lite
6		1	Fiber Washer at End Head
7	MAU#2001	1	Frame and Field Assembly
8	SK-1467	1	Spacer
9		2	Am. Std. #505 Woodruff Key
10	SK-1466	1	Trip Motor Drum
11		2	3/8"-16 N.C. Allen Set Screw
12	17-624B	1	Trip Motor Suppt.
13	SK-1465	1	Brg. Retainer Plt.
14	ND#88016	2	Ball Bearing
15		2	1/4"-20 N.C. Hex. Hd. Cap Scr. x 5/8" Lg.
16		6	1/4" Lockwasher
17		4	1/4"-20 N.C. Hex. Hd. Cap Scr. x 3/4" Lg.
18	17-666B	1	Dipper Trip Cover
19	MAB#1024F	1	Head Band Cover - Elect. Auto-Lite
20	MAB#2002	1	Commutator End Head - Elect. Auto-Lite
21		2	1/2"-20 N.F. Hex. Hd. Cap Scr. x 1 3/4" Lg.
22		2	1/2"-20 N.F. Hex. Nut
23		2	3/8" Lockwasher
24		2	1/4"-20 N.C. Hex. Nut
25	17-1045A	1	Trip Brake Adj. Screw
26	17-1046A	1	Trip Brake Spring
27	17-1047A	1	Trip Brake Band
28		1	3/8"-16 N.C. Hex. Cap Screw 2 1/4" Lg.
29		1	3/8"-16 N.C. Hex. Nut

PILE DRIVER ASSEMBLY

See Reverse Side for Part Numbers and Description.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Ground Line

Note:
30 Ft. Boom Shown.
To Assemble Pile Driver Leads:- Remove Boom Pt. Sheave Guards & Mount Lead Adapters On Boom Pt. Shaft, Outside Bridle.

To Assemble Catwalk:- Remove Boom Snubber. Catwalk Adapters Fit Between Boom Feet; Use Snubber Arm Pins & Cotters.

When Ordering Parts Always give Serial Number of Machine

WAYNE CRANE DIVISION, AMERICAN STEEL DREDGE CO. INC., FORT WAYNE, IND.

Pile Driver Assembly - Complete 17-1016D

(See Reverse Side for Illustration)

Assembly Consists of:

Item	Part No.	Qty.	Name of Part
1		1	5/8" Dia. Cable x 75' Lg.
2	17-1015A	2	Lead Adapter
3		12	3/4"-16 N.F. Hex. Hd. Cap Scr. x 1 3/4"
4		28	3/4"-16 N.F. Hex. Nut
5		28	3/4" Lockwasher
6	17-1011D	1	20' Head Section
7		16	3/4"-16 N.F. Hex. Hd. Cap Scr. x 2"
8		4	7/8"-14 N.F. Hex. Hd. Cap Scr. x 3"
9		4	7/8"-14 N.F. Hex. Nut
10		4	7/8" Lockwasher
11	17-1011D	1	10' Lower Section
12	17-1014A	2	Catwalk Adapter
13		8	3/8"-16 N.C. Hex. Hd. Bolt x 1 1/4"
14		8	3/8"-16 N.C. Hex. Nut
15		8	3/8" Lockwasher
16	17-1013D	1	Telescoping Catwalk
17	17-1013D	2	Tie Rod
18		8	1/2"-13 N.C. Hex. Nut
19		8	1/2" Lockwasher
20		6	1/2"-13 N.C. Hex. Hd. Bolt x 1 1/2"
21		1	5/8" Dia. Cable - Single Eye Socket & Wedge
22		1	1 1/4" Rd. Pin Chain Shackle
*23	D5829-3	1	3000# Drop Hammer (With Pins)
24		1	1/2" Dia. Cable x 12' Lg.
25		2	1/2" Cable Clips
*26	D5829-4	1	Cushion Block & Stl. Band
*27	D5829-4-1	1	Pile Cap

*Corps of Engineers Drawing No.

PARTS LIST INDEX

Hendrickson Motor Truck Co. Ten Ton Crane Carrier

Section	Part
1	Front Axle Assembly
2	Rear Axle Assembly
3	Timken Axle Drawings
4	Service Brakes
5	Emergency Brakes
6	Clutch
7	Fuel Tank
8	Engine
9	Carburetor
10	Cab Assembly
11	Ignition and lighting
12	Radio Suppression
13	Muffler
14	Propeller Shafts & Univer
15	Radiator
16	Steering Gear
17	Transmission
18	Transfer Case
19	Tools and Equipment
20	Dash Panel Instruments

PARTS LIST

VENDOR: The Timken-Detroit Axle Co.

F-3200-WX-20

Front Axle Assembly

PART NO.	DESCRIPTION	NO. REQ.
	Arm -- Steering	
2910-Q-17	Ball -- Steering Arm	
53176	Bearing -- Knuckle Pivot - Cone	
53387	Bearing -- Knuckle Pivot - Cup	
S-1822	Bolt -- Cross Tube End Clamp	
1825-S-71	Bushing -- Cross Tube End Pin	
1825-E-31	Bushing -- Steering Knuckle	
3866-F-136	Cap -- Knuckle Flange Bearing - Upper	
3866-G-137	Cap -- Knuckle Flange Bearing - Lower	
3944-H-8	End -- Cross Tube - 12 Thread	
3944-B-28	End -- Cross Tube - 16 Thread	
5-X-322	Felt -- Trunnion Socket	
A2-3897-D-264	Flange -- Knuckle Companion - Assembly - R.H.	
A3-3897-D-264	Flange -- Knuckle Companion - Assembly - L.H.	
A-3897-V-100	Knuckle -- Steering - with Bushing Assembly	
N-18	Nut -- Cross Tube End Clamp Bolt	
1827-K-89	Nut -- Cross Tube End Lock	
1827-J-88	Nut -- Cross Tube End Pin	
1227-R-252	Nut -- Knuckle Comp. Flange Screw	
N-110	Nut -- Knuckle Flange Bearing Cap Stud - Inner	
13-X-14	Nut -- Knuckle Flange Bearing Cap Stud - Outer	
13-X-47	Nut -- Knuckle Flange Stop Screw	
1227-S-253	Nut -- Knuckle Flange Stud	
N-212	Nut -- Steering Arm Ball	
10-X-216	Pin -- Cross Tube End	
1246-L-272	Pin -- Cross Tube End Lock	
2847-V-126	Pin -- Knuckle Bearing	
1805-M-39	Retainer -- Knuckle Bearing Grease	
S-1815-1	Screw -- Knuckle Comp. Flange	
S-21012-1	Screw -- Knuckle Flange Brg. Cap	
10-X-260	Screw -- Knuckle Flange Stop	
2803-W-309	Shim -- Knuckle Flange Brg. Cap	
2803-X-310	Shim -- Knuckle Flange Brg. Cap	
A-3897-R-96	Socket -- Trunnion - Assembly	
1818-B-2	Spring -- Trunnion Socket Felt	
4-X-73	Stud -- Knuckle Flange	
4-X-389	Stud -- Knuckle Flange Brg. Cap - Long	
4-X-526	Stud -- Knuckle Flange Brg. Cap - Short	
A-3902-R-18	Tube -- Steering Cross - and end assy.	
WA-18	Washer -- Cross Tube End Clamp Bolt	
WA-18	Washer -- Knuckle Comp. Flange Screw	
WA-110	Washer -- Knuckle Flange Brg. Cap Screw	
1229-X-518	Washer -- Knuckle Flange Brg. Cap Stud Nut	

PARTS LIST

VENDOR: The Timken-Detroit Axle Co.

F-3200-WX-20

Front Axle
Assembly

PART NO.	DESCRIPTION	NO. REQ.
WA-19	Washer -- Knuckle Flange Stud Nut	
	Hub Parts	
71450	Bearing -- Wheel - Cone - Inner	
52400	Bearing -- Wheel - Cone - Outer	
71750	Bearing -- Wheel - Cup - Inner	
52637	Bearing -- Wheel - Cup - Outer	
1807-B-2	Cover -- Brake Drum Inspection	
3819-Q-17	Brake Drum	
5-X-328	Felt -- Wheel Bearing	
A-322-C-107	Hub Assembly	
1829-V-152	Lock -- Wheel Brg. Nut	
N-110	Nut -- Hub and Shaft Flange Stud	
13-X-28	Nut -- Hub and Drum Stud	
1199-H-112	Nut -- Hub and Wheel Stud Cap-RH-3/4"-16-Budd Single Wheel	
1199-G-111	Nut -- Hub and Wheel Stud Cap-LH-3/4"-16-Budd Single Wheel	
1199-N-118	Nut -- Hub and Wheel Stud Cap-RH-1-1/8-16-Budd Single Wheel	
1199-M-117	Nut -- Hub and Wheel Stud Cap-LH-1-1/8-16-Budd Single Wheel	
A-1827-W-49	Nut -- Wheel Bearing Adj.	
1827-X-50	Nut -- Wheel Bearing Jam.	
1829-B-158	Retainer - Wheel Bearing Felt	
S-244	Screw -- Brake Drum Insp. cover	
3897-H-190	Spacer -- Wheel	
4-X-180	Stud -- Hub and Shaft Flange	
20-X-20	Stud -- Hub and Wheel-RH - 3-1/8" long	
20-X-19	Stud -- Hub and Wheel-LH - 3-1/8" long	
20-X-58	Stud -- Hub and Wheel - RH - 4-7/32" long	
20-X-59	Stud -- Hub and Wheel - LH - 4-7/32" long	
20-X-90	Stud -- Hub and Wheel - RH - 3-3/16" long	
20-X-89	Stud -- Hub and Wheel - LH - 3-3/16" long	
WA-14	Washer - Brake Drum Insp. Cover Screw	
WA-110	Washer -- Hub and Shaft Flange Stud	
1829-W-153	Washer -- Wheel Bearing Nut	
3256-C-3	Wrench -- Wheel Bearing Nut	
10-X-189	Bolt -- Brake Shoe Link	
3899-F-162	Bracket -- Brake Diaphragm - RH	
3899-E-161	Bracket -- Brake Diaphragm - LH	
1825-G-59	Bushing -- Brake Camshaft	
1825-K-37	Bushing -- Brake Shoe	
	Diaphragm -- Service by Westinghouse	
A-1893-U-203	Fitting -- Brake Anchor Pin Alemite	

VENDOR: The Timken-Detroit Axle Co.	PARTS LIST F-3200-WX-20 Front Axle Assembly

PART NO.	DESCRIPTION	NO. REQ.
	Lever -- Slack Adj. - Serviced by West.	
2840-H-8	Lining -- Brake Shoe	
1845-A-1	Link -- Brake Shoe	
1827-Z-130	Nut -- Brake Shoe Anchor Pin	
N-28	Nut -- Brake Shoe Link Bolt	
1859-B-2	Pin -- Brake Shoe Anchor	
1846-M-65	Pin -- Brake Shoe Cam Plate	
1898-E-213	Plate -- Brake Dust Shield	
2817-A-1	Plate -- Brake Shoe Cam	
1854-B-80	Ring -- Brake Cam Shaft Snap	
17-X-40	Rivet -- Brake Shoe Lining	
S-2812	Screw -- Brake Diaphragm Bracket	
S-264	Screw -- Brake Dust Shield	
S-267	Screw -- Brake Dust Shield Plate	
2810-E-239	Shaft -- Brake Cam - RH	
2810-E-240	Shaft -- Brake Cam - LH	
3836-N-144	Shield -- Brake Dust	
A1-3822-E-5	Shoe -- Brake Assy. - RH lower	
A1-3822-F-6	Shoe -- Brake Assy. - LH lower	
A2-3822-F-6	Shoe -- Brake Assy. - RH upper	
A2-3822-E-5	Shoe -- Brake Assy. - LH upper	
2858-S-97	Spring -- Brake Shoe	
WA-116	Washer -- Brake Anchor Pin Nut	
WA-18	Washer -- Brake Diaphragm Bracket Screw	
WA-16	Washer -- Brake Dust Shield Plate Screw	
WA-16	Washer -- Brake Dust Shield Screw	
	Housing Parts	
A-1199-E-421	Breather -- Axle Housing - Assembly	
3885-A-1	Filler -- Housing Oil	
2808-N-300	Gasket -- Housing Oil Filler	
A-3801-Y-77	Housing --Axle - Assembly	
P-28	Plug -- Housing Oil Drain	
P-120	Plug -- Housing Oil Filler	
A-1805-X-128	Seal -- Axle Shaft Inner Oil	
3816-E-83	Tube -- Axle Housing - Long	
3816-D-82	Tube -- Axle Housing - Short	
	Misc. Parts	
15-X-209	Bolt -- Housing and Carrier thru	
3-X-168	Bolt -- Housing and Socket	
2808-K-167	Gasket -- Housing and Carrier	
N-48	Nut -- Housing and Carrier Stud	
N-110	Nut -- Housing and Carrier Thru Bolt	
N-210	Nut -- Housing and Carrier thru bolt - castle	
N-49	Nut -- Housing and Socket Bolt	

PARTS LIST

VENDOR: The Timken-Detroit Axle Co.	F-3200-WX-20 Front Axle Assembly

PART NO.	DESCRIPTION	NO. REQ.
4-X-186	Stud -- Housing and Carrier	
WA-18	Washer -- Housing and Carrier Stud Nut	
1829-P-172	Washer -- Housing and Carrier Thru Bolt	
1829-L-298	Washer -- Housing and Carrier Thru Bolt - Lower	
WA-110	Washer -- Housing and Carrier thru bolt lock	
WA-19	Washer -- Housing and socket bolt nut	
	Axle shaft and Universal parts.	
1898-T-72	Ball -- Universal Joint Cage	
1898-S-71	Cage -- Universal Joint Ball	
1246-Y-233	Dowel -- Axle Shaft Drive Flange	
3870-E-57	Flange -- Axle Shaft Drive	
2808-H-164	Gasket -- Axle Shaft Flange	
2808-W-138	Gasket -- Axle Shaft Retainer	
N-38	Nut -- Axle Flange Puller Screw	
5-X-385	Packing -- Axle Shaft Flange	
1898-X-76	Pilot -- Universal Joint Cage	
1898-Y-77	Pin -- Universal Joint Pilot	
1898-N-66	Plunger -- Universal Joint Pilot Pin	
3897-Z-234	Race -- Universal Joint - Outer	
A-1898-J-114	Race -- Universal Joint Ball Inner	
1898-K-193	Retainer -- Universal Joint and Shaft	
1829-L-402	Retainer -- Axle Shaft	
5-2810	Screw -- Axle Shaft Flange Puller	
S-157	Screw -- Axle Shaft Retainer	
1898-W-75	Screw -- Universal Joint and Shaft Ret.	
A- 3802 -B-496	Shaft -- Axle - Assembly - Long	
A-3802-A-495	Shaft -- Axle 0 Assembly - Short	
1898-Q-69	Spring -- Universal Joint Pilot Pin Buffer	
1898-W-439	Spring -- Universal Joint Pilot Pin Plunger	
A1-3897-Z-234	Universal -- Axle Shaft - Join Assembly.	
1829-K-401	Washer -- Axle Shaft	
WA-15	Washer -- Axle Shaft Ret. Screw	
	Driving Unit Parts	
59200	Bearing -- Bevel Pinion - Cone - Fwd.	
623	Bearing -- Bevel Pinion - Cone - Rear.	
59412	Bearing -- Bevel Pinion - Cup - Fwd.	
612	Bearing -- Bevel Pinion - Cup - Rear.	
581	Bearing -- Differential - Cone	
572	Bearing - Differential - Cup	
623	Bearing -- Spur Pinion - Cone R. H.	
65225	Bearing -- Spur Pinion - Cone L. H.	
612	Bearing -- Spur Pinion - Cup R. H.	
65500	Bearing -- Spur Pinion - Cup L. H.	
15-X-130	Bolt -- Differential Case	

PARTS LIST

VENDOR: The Timken-Detroit Axle Co.	F-3200-WX-20 Front Axle Assembly

PART NO.	DESCRIPTION	NO. REQ.
A-3826-U-151	Cage -- Bevel Pinion Bearing - Assy.	
A-3838-S-45	Cage -- Spur Pinion Bearing - Assy.	
A2-3800-U-359	Carrier -- With bearing cap assy.	
G-380	Carrier -- Complete assembly w/9.16 ratio	
3866-G-189	Cover -- Spur Pinion Bearing - Gear Slide	
A-3866-Z-182	Cover -- Spur Pinion Bearing - Assembly	
A3-3835-L-38	Differential -- Assembly	
A-3835-M-39	Differential -- Case Assembly	
A7-3835-L-38	Differential -- with spur gear assembly	
2808-K-323	Gasket -- Bevel Pinion Cage	
2808-N-300	Gasket -- Carrier Insp. Plug	
2808-A-183	Gasket -- Spur Pinion Bearing Cage	
2808-V-22	Gasket -- Spur Pinion Bearing Cover - Gear Side	
2808-A-183	Gasket -- Spur Pinion Bearing Cover	
3889-W-179	Gear -- Bevel	
3890-S-253	Gear -- Bevel Pinion	
2233-W-413	Gear -- Differential Pinion	
2834-N-66	Gear--Differential Side	
3892-X-622	Gear -- Spur 9.16 Ratio	
3891-B-470	Gear -- Spur Pinion 9.16 Ratio	
1820-N-40	Lock -- Differential Bearing Adj. Ring	
1829-G-7	Lock--Spur Pinion Bearing	
16278	Nut -- Bevel Pinion	
N-19	Nut -- Bevel Pinion Bearing Cage Stud	
N-212	Nut -- Differential Bearing Cap Stud	
N-29	Nut -- Differential Case Bolt	
N-19	Nut -- Spur Pinion Brg. Cage Stud - 9/16 - 18	
N-18	Nut -- Spur Pinion Brg. Cage Stud - 1/2 - 20	
N-18	Nut -- Spur Pinion Brg. Cover Stud	
1850-V-48	Plug -- Bevel Pinion Brg. Cage Oil	
1850-A-1	Plug -- Carrier Inspection	
2814-E-57	Ring -- Differential Bearing Adj.	
S-286-D1	Screw -- Differential Brg. Adj. Ring Lock	
S-278-D	Screw -- Spur Pinion Bearing Lock	
A-1805-Y-155	Seal -- Bevel Pinion Brg. Cage Oil	
2803-Y-519	Shim -- Bevel Pinion Brg. Cage - Thin	
2803-Z-520	Shim -- Bevel Pinion Brg. Cage - Med.	
2803-A-521	Shim -- Bevel Pinion Brg. Cage - Thick	
2803-E-239	Shim -- Bevel Pinion Brg. - .021	
2803-F-240	Shim -- Bevel Pinion Brg. - .024	
2803-G-241	Shim -- Bevel Pinion Brg. - .030	
2803-H-242	Shim -- Bevel Pinion Brg. - .034	
2803-H-346	Shim -- Spur Pinion Brg. Cover - Thin	
2803-U-348	Shim -- Spur Pinion Brg. Cover - Thick	

PARTS LIST

VENDOR: The Timken-Detroit Axle Co.	F-3200-WX-20 Front Axle Assembly

PART NO.	DESCRIPTION	NO. REQ.
2803-K-349	Shim -- Spur Pinion Brg. Cover - Med.	
2803-C-55	Shim -- Spur Pinion Brg. Cover - Thin-Gear Side	
2803-D-56	Shim -- Spur Pinion Brg. Cover - Thick-Gear Side	
2803-Y-571	Shim -- Spur Pinion Brg. Cover - .003 - Gear Side	
1844-W-153	Spacer -- Bevel Pinion Bearing	
3878-C-3	Spider -- Differential	
4-X-545	Stud -- Differential Bearing Cap	
4-X-173	Stud -- Bevel Pinion Bearing Cage	
4-X-397	Stud -- Spur Pinion Brg. Cage - 2" long	
4-X-73	Stud -- Spur Pinion Brg. Cage - 2-1/8" long	
WA-19	Washer -- Bevel Pinion Brg. Cage Stud	
1829-Y-363	Washer -- Bevel Pinion Nut	
1829-S-45	Washer -- Differential Pinion Gear Thrust	
1229-X-882	Washer -- Differential Side Gear Thrust	
WA-18	Washer -- Spur Pinion Bearing Cage Stud - 1/2	

VENDOR: The Timken-Detroit Axle Co.

SD-3020 PA

REAR AXLE ASSEMBLY

Part No.	Description	No. Req'd
A1-3201-D-1304	HOUSING GROUP	
A2-3201-D-1304	Housing assy.	2
A-1199-W-1219	breather assy.	2
P-116	filler hole plug	2
P-216	drain hole plug	2
3216-N-846	sleeve - long	2
3216-Q-589	short	2
S-686	set screw	4
1199-L-974	oil sleeve adapter	2
1199-Z-832	adapter	2
A-1205-P-146	Axle shaft oil seal assy.	4
AT-5370	Wheel brg. nut & dowel assy.	4
T-5372	nut - outer	4
	MISCELLANEOUS	
1246-B-28	Differential carrier dowel	8
2208-C-237	& housing gasket	2
4-X-186	stud	28
N-18	nut	28
WA-48	lockwasher	20
1229-V-516	shake proof washer	8
T-5373	Wheel brg. nut washer	4
3256-D-4	wrench	1
A-3280-W-1453	Spring pad & dowel assy. - R. H. fwd. - L. H. rear	2
A1-3280-W-1453	L. H. fwd. - R. H. rear	2
T-6193	dowel	4
2297-B-288	Spring pad clip	4
N-112	nut	8
WA-112	Spring pad clip nut lockwasher	8
2203-F-422	Spring pad clip shim - thin	4
2203-G-423	thick	4
A-3280-E-1669	Torque rod support & pin assy. - R. H. fwd. - L. H. rear	2
A-3280-F-1670	L. H. fwd. - R. H. rear	2
2110-N-40	pin	4
1199-N-664	nut	4
RV-11017	Housing & torque rod support rivet	24
3-X-116	bolt	8
N-110	nut	8
WA-110	lockwasher	8
	AXLE SHAFT GROUP	
A-3202-J-1388	Axle shaft & puller screw assy. - short	2
A-3202-L-1390	- long	2
X-1680	puller screw	8
X-768	nut	8

Part No.	Description	No. Req'd
	Thru shaft brg. cover assy. - rear	
4-X-186	stud	12
N-18	nut	12
WA-18	lockwasher	12
566	Bevel pinion brg. cone - front	1
3975	rear	1
563	cup - front	1
3920	rear	1
3889-U-177	Bevel gear	1
16-X-53	key	1
1828-L-38	Bevel gear bearing	1
1844-L-116	spacer	1
1821-D-4	sleeve	1
10-X-197	screw	1
3855-E-57	Diff. carrier top cover	1
2808-C-3	gasket	1
S-266	capscrew	10
WA-16	lockwasher	10
A-3280-G-1983	Companion flange & slinger - Fwd.	1
A-3280-E-1981	yoke & slinger - rear	1
	DRIVING UNIT (REAR AXLE)	
A1-3800-Z-416	Diff. carrier assy. complete	1
A2-3800-Z-416	& cap assy.	1
4-X-175	bearing cap stud	4
N-212	nut	4
581	cone	2
572	cup	2
2814-B-2	adjusting nut	2
1820-B-2	lock	2
S-286-D	capscrew	2
IW-1612	lockwire	2
A3-3835-L-38	Differential assy.	1
A-3835-M-39	case assy.	1
15-X-130	bolt	8
N-29	nut	8
K-2410	cotter	8
2834-N-66	side gear	2
1229-X-882	washer	2
2833-B-2	pinion	4
1829-S-45	Differential pinion thrust washer	4
3878-C-3	spider	1
A-4-3835-L-38	Diff. & helical gear assy.	1
3892-K-609	Helical gear - 6.84	1
3892-J-608	7.50	1
3892-H-606	8.27	1
3892-G-605	9.16	1
3892-F-604	10.22	1
3891-K-453	Helical pinion 6.84	1

VENDOR: The Timken-Detroit Axle Co.

SD-3020 PA

REAR AXLE ASSEMBLY

Part No.	Description	No. Req'd
	DRIVING UNIT (REAR AXLE) (Continued)	
	Helical pinion	
3891-J-452	7.50	1
3891-H-450	8.27	1
3891-G-449	9.16	1
3891-F-448	10.22	1
66225	Gear shaft brg. cone	2
66462	cup	2
1829-S-149	lockwasher	1
S-278-D	capscrew	3
IW-166	lockwire	1
A3826-A-157	cage	1
2805-U-47	gasket	2
2803-X-518	shim	6
2803-C-107	shim	6
2803-D-108	shim	3
3866-Z-338	cover - L. H.	1
4-X-548	stud	6
N-18	nut	6
WA-18	lockwasher	6
3266-G-85	cover - R. H.	1
2208-D-238	Gear shaft cover gasket	1
S-288	capscrew	8
WA-18	lockwasher	8
A-3380-T-462	Thru shaft & bevel pinion assy.	1
14-X-57	nut - front	1
1829-V-363	washer	1
K-2416	cotter	1
2297-R-512	rear brg. spacer	1
14-X-58	Thru shaft rear brg. nut	1
K-2620	cotter	1
A-1805-V-152	Thru shaft brg. oil seal assy.	1
A-3866-X-336	cover - assy. - fwd.	1
2808-R-330	gasket	1
2803-H-632	shim - .003	1
2803-Q-537	thin	6
2803-R-538	thick	1
3866-A-339	rear	1
2808-P-328	gasket	1
2803-G-631	shim - .003	1
2803-K-531	thin	6
2803-L-532	thick	1
4-X-186	stud	12
N-18	nut	12
WA-18	lockwasher	12

Part No.	Description	No. Req'd
3975	Bevel pinion brg. cone - front	1
566	rear	1
3920	cup - front	1
563	rear	1
3889-U-177	Bevel gear	1
16-X-53	key	1
1828-L-38	bearing	1
1844-L-116	spacer	1
1821-D-4	sleeve	1
10-X-197	screw	1
3855-E-57	Diff. carrier top cover	1
2808-C-3	gasket	1
S-266	capscrew	10
WA-16	lockwasher	10
A-3280-E-1981	Companion yoke & slinger assy.	1
	CHASSIS GROUP	
A-3216-Q-1421	Connecting tube & center brkt. assy.	1
2297-E-447	adj. nut	2
1220-F-32	lock	2
S-1826	clampbolt	2
N-18	nut	2
WA-18	washer	2
5-X-477	packing	2
1244-A-443	spacer	2
1250-Q-95	oil plug	2
1250-F-136	filler	2
1229-Q-979	washer	2
P-112	plug	2
3280-C-1433	Connecting tube bracket	2
S-1618	bolt	4
N-16	nut	4
WA-16	lockwasher	4
A11-3102-T-1190	Torque rod assy. - lower	4
A-2297-E-603	end ball & brg. assy.	8
A8-3102-T-410	Torque rod assy. - upper	4
A3-3144-R-148	end assy. - L. H. thd.	4
A-2297-D-602	ball & brg. assy.	4
2257-F-6	clamp	8
3X-45	clampbolt	8
13X-7	nut	8
WA-110	lockwasher	8
A3-3144-S-149	Torque rod assy. - R. H. thd.	4
A-2297-C-601	ball & brg. assy.	4
A-2110-H-60	Torque rod end pin & nut assy. center - lower	4
1227-E-83	nut	4
1227-V-204	nut	4
A-2110-U-73	axle end - lower	4
1227-E-83	nut	8
1229-D-758	lock	4

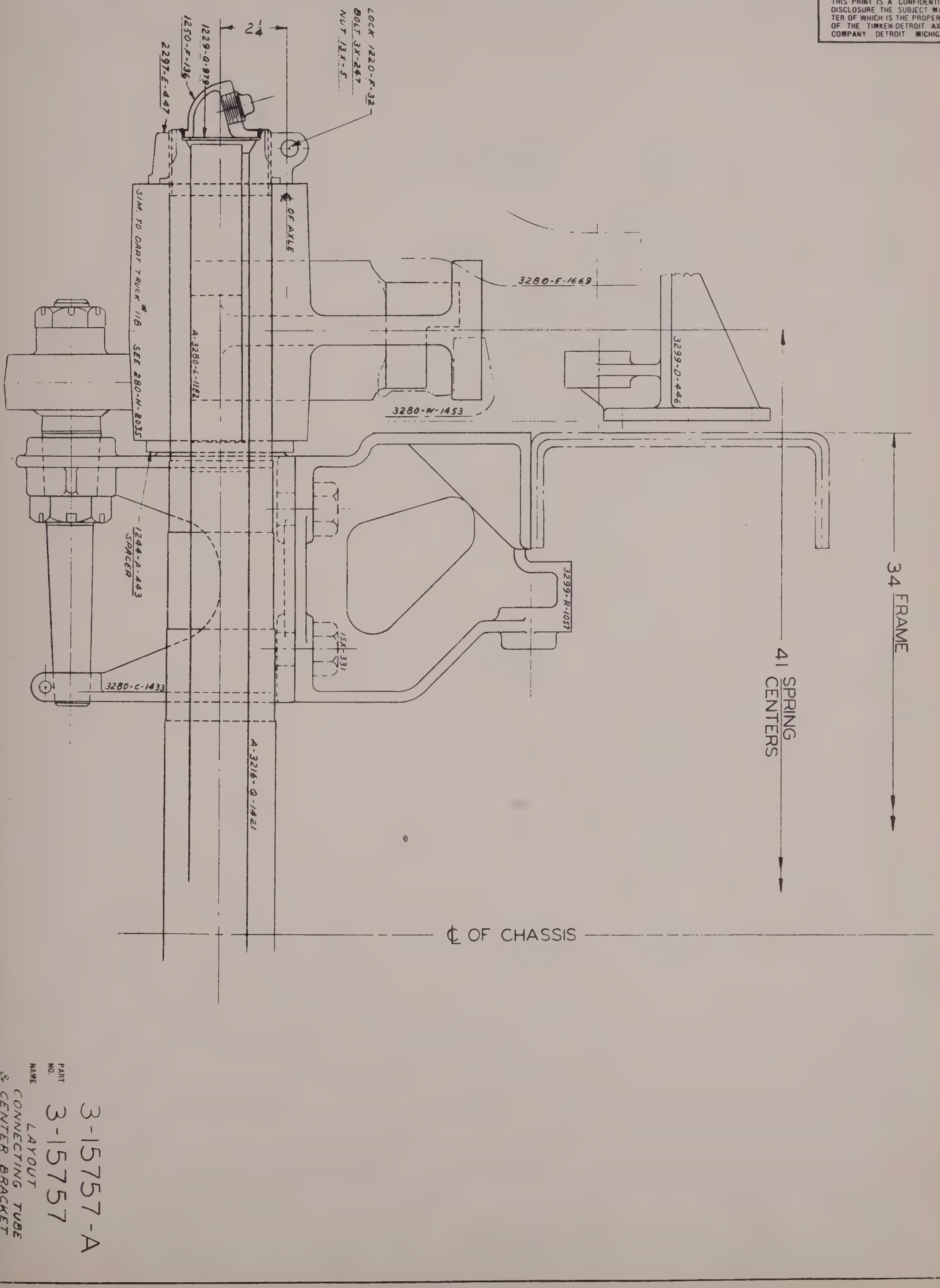
VENDOR: The Timken-Detroit Axle Co.	SD-3020 PA REAR AXLE ASSEMBLY

Part No.	Description	No. Req'd
	CHASSIS GROUP (Continued)	
	Torque rod end pin & nut assy. center - lower	
K-2618	cotter	12
K-2620	cotter	4
3299-Q-1057	Frame support bracket	2
A15-X-331	bolt & nut assy.	8
WA-118	nut lockwasher	16
3299-D-446	Torque rod frame bracket	2
1246-R-174	pin	4
7-X-8	key	4

VENDOR: The Timken-Detroit Axle Company

3-15757
Layout
Connecting Tube
& Center Bracket

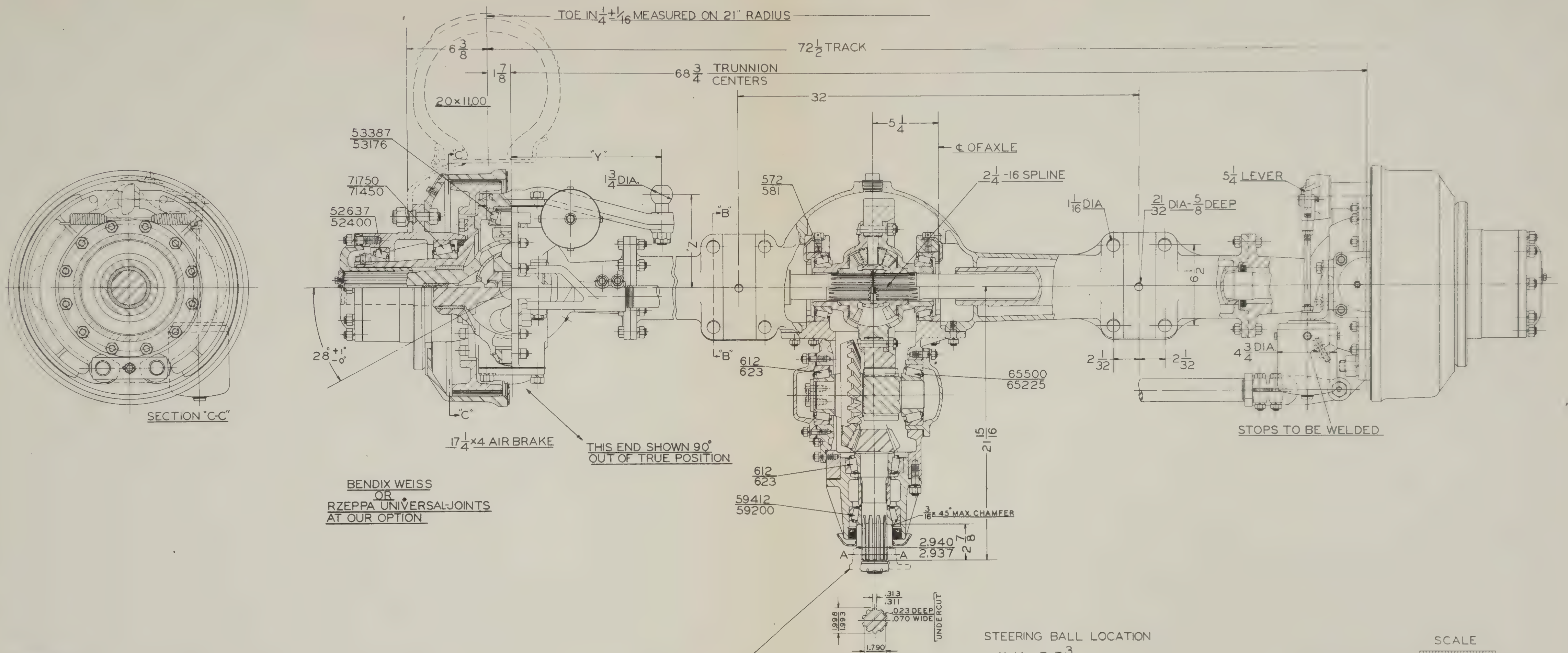
THIS PRINT IS A CONFIDENTIAL DISCLOSURE THE SUBJECT MATTER OF WHICH IS THE PROPERTY OF THE TIMKEN-DETROIT AXLE COMPANY DETROIT MICHIGAN

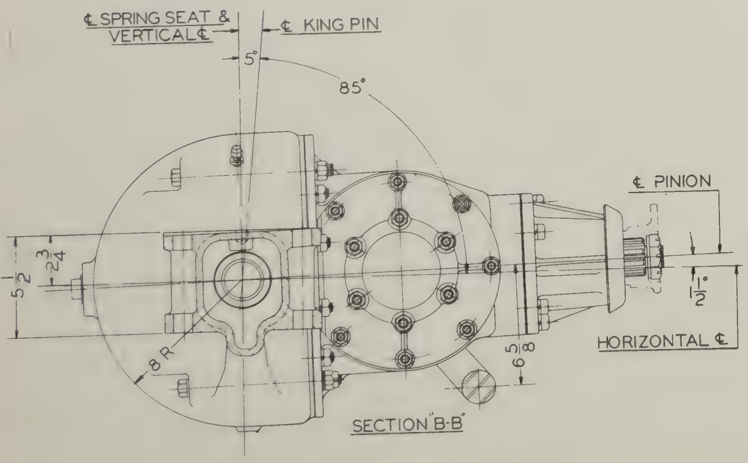

2297-E-447
1250-F-136
1229-Q-979
2¼
LOCK 1220-F-32
BOLT 3X-247
NUT 13X-5
℄ OF AXLE
SIM. TO DART TRUCK #118. SEE 280-H-2035
A-3280-L-1182
3280-E-1669
3299-D-446
3280-W-1453
1244-A-443 SPACER
3299-R-1057
15X-331
3280-C-1433
A-3216-Q-1421
41 SPRING CENTERS
34 FRAME
℄ OF CHASSIS
3-15757-A
PART NO. 3-15757
NAME LAYOUT CONNECTING TUBE & CENTER BRACKET
ORIGINAL FOR SW-3C10-P. (DART)
DRAWN BY G.C.R. 6-4-46 CHECKED BY F.M. 7-2-46
R.E. REN 9 10

	PARTS LIST
VENDOR: The Timken-Detroit Axle Company	F-3200-W Double Reduction Front Axle

SEE INSIDE

F-3200-W Double Reduction Front Axle


TOE IN 1/4 ± 1/16 MEASURED ON 21" RADIUS
6 3/8
72 1/2 TRACK
1 7/8
68 3/4 TRUNNION CENTERS
20×11.00
32
5 1/4
¢ OF AXLE
53387
53176
"C"
"Y"
71750
71450
1 3/4 DIA.
52637
52400
"B"
Z
572
581
2 1/4 -16 SPLINE
1 1/16 DIA
21/32 DIA - 5/8 DEEP
5 1/4 LEVER
6 1/2
28° +1° -0°
"B"
612
623
65500
65225
2 1/32
2 1/32
4 3/4 DIA
SECTION "C-C"
"C"
17 1/4 × 4 AIR BRAKE
THIS END SHOWN 90° OUT OF TRUE POSITION
21 15/16
STOPS TO BE WELDED
BENDIX WEISS OR RZEPPA UNIVERSAL-JOINTS AT OUR OPTION
612
623
59412
59200
3/16 × 45° MAX. CHAMFER
2.940
2.937
2 7/8
A
A
.313
.311
1.998
1.993
.023 DEEP
.070 WIDE
UNDERCUT
1.790
1.785
SECTION "A-A"
STEERING BALL LOCATION
Y = 14 – Z = 7 3/8
Y = 12 – Z = 7 3/8
SCALE
0 1 2 3 4 5 6
FLANGE TO BE FURNISHED BY CUSTOMER TO BE ASSEMBLED BY TIMKEN.


¢ SPRING SEAT & VERTICAL ¢
¢ KING PIN
5°
85°
¢ PINION
5 1/2
2 3/4
1 1/2°
8 R
6 5/8
HORIZONTAL ¢
SECTION "B-B"

AXLE SPECIFICATIONS

SPRING MOUNTING—Spring seats cast integral with housing for overslung springs.

TRACK—72½" with single 10.00 x 22 tires on 6⅜" offset wheels. Special track 73⅛" with 15/16" wheel spacers, single 11.00 x 20 tires on 7" offset wheels.

PINION SHAFT END—2" 10-splines.

GEARS—Double reduction drive. First reduction is through a spiral bevel gear and pinion, second through a set of spur gears. Gears are of special electric furnace steel with teeth carburized and hardened.

AVAILABLE RATIOS—8.27, 9.16 and 10.22.

AXLE SHAFTS—Axle shafts are full floating with 2 1/16" diameter body and 2¼" 16-spline inner end. Universal joint in axle shaft is "constant velocity" type.

HOUSING—Malleable iron casting with sleeves of seamless steel tubing. Built throughout for greatest strength and rigidity.

BRAKES—17¼" x 4" air operated. Supplied with air cylinders and slack adjusters.

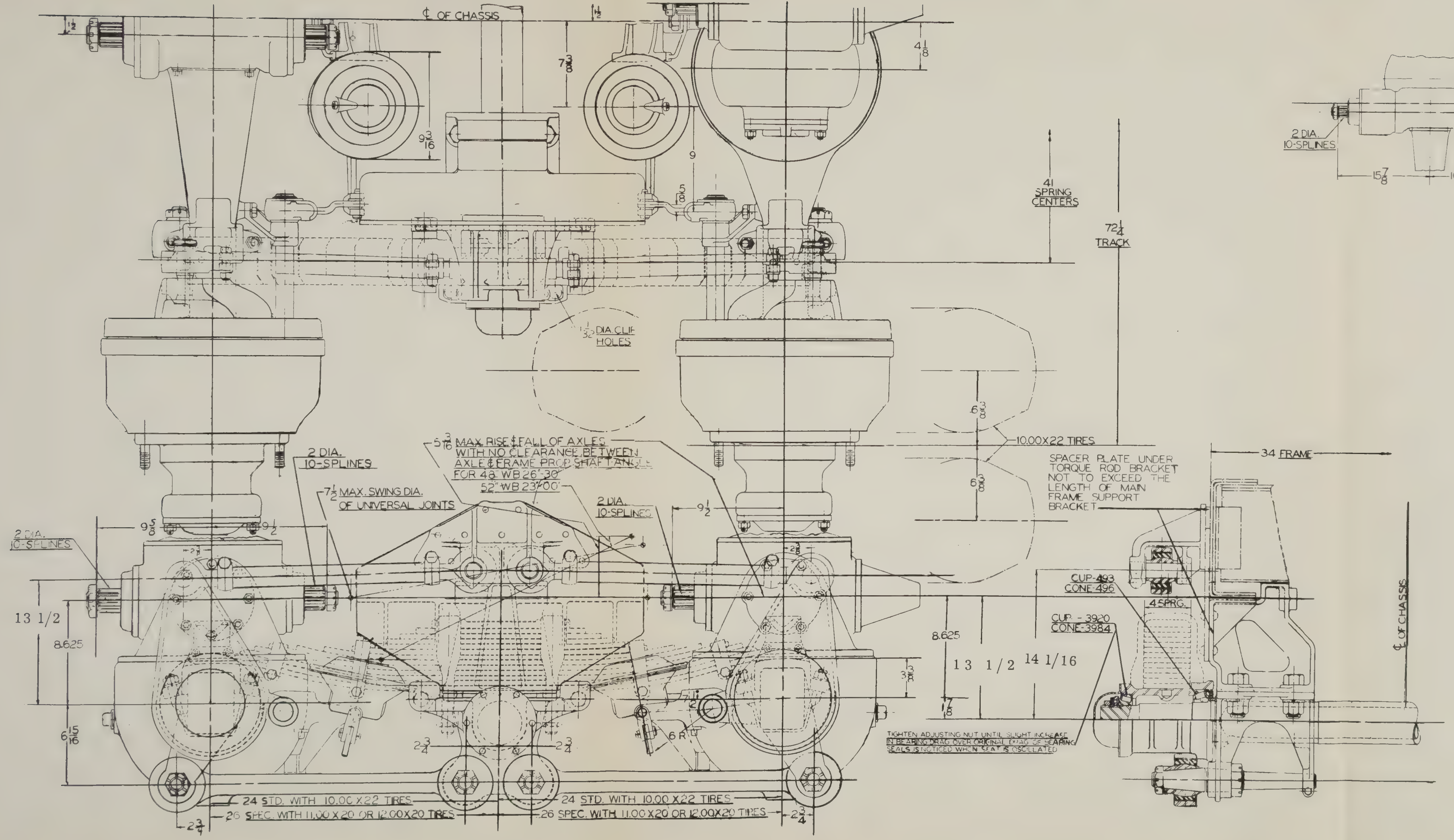
NET SHIPPING WEIGHT—Axle complete, approximately 1575 pounds.

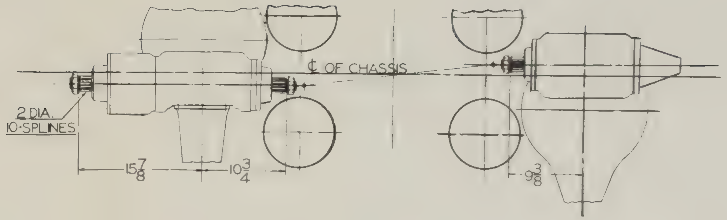
VENDOR: Timken-Detroit Axle Company	SD-3020-PA Assembly Six-Wheel PA Brakes - 4 Torque Rods

SEE INSIDE

SD-3020-PA

TIMKEN-DETROIT AXLE CO.
Assembly Six-Wheel
PA Brakes - 4 Torque Rods


℄ OF CHASSIS
1/2
7 3/8
4 1/8
9 3/16
9
5/8
41 SPRING CENTERS
72 1/4 TRACK
1 1/32 DIA CLIP HOLES
6 3/8
10.00X22 TIRES
6 3/8
34 FRAME
SPACER PLATE UNDER TORQUE ROD BRACKET NOT TO EXCEED THE LENGTH OF MAIN FRAME SUPPORT BRACKET
5 3/16 MAX RISE & FALL OF AXLES WITH NO CLEARANCE BETWEEN AXLE & FRAME PROP SHAFT ANGLE FOR 48" WB 26°-30' 52" WB 23°-00'
2 DIA. 10-SPLINES
7 1/2 MAX. SWING DIA. OF UNIVERSAL JOINTS
2 DIA. 10-SPLINES
9 1/2
9 5/8
9 1/2
2 DIA. 10-SPLINES
CUP-493 CONE-496
4 SPRG.
CUP - 3920 CONE-3984
℄ OF CHASSIS
13 1/2
8.625
8.625
13 1/2
14 1/16
7/8
3 3/8
6 15/16
2 3/4
2 3/4
6 R
2
TIGHTEN ADJUSTING NUT UNTIL SLIGHT INCREASE IN BEARING DRAG OVER ORIGINAL DRAG OF BEARING SEALS IS NOTICED WHEN SEAT IS OSCILLATED
24 STD. WITH 10.00X22 TIRES
24 STD. WITH 10.00X22 TIRES
26 SPEC. WITH 11.00X20 OR 12.00X20 TIRES
26 SPEC. WITH 11.00X20 OR 12.00X20 TIRES
2 3/4
2 3/4

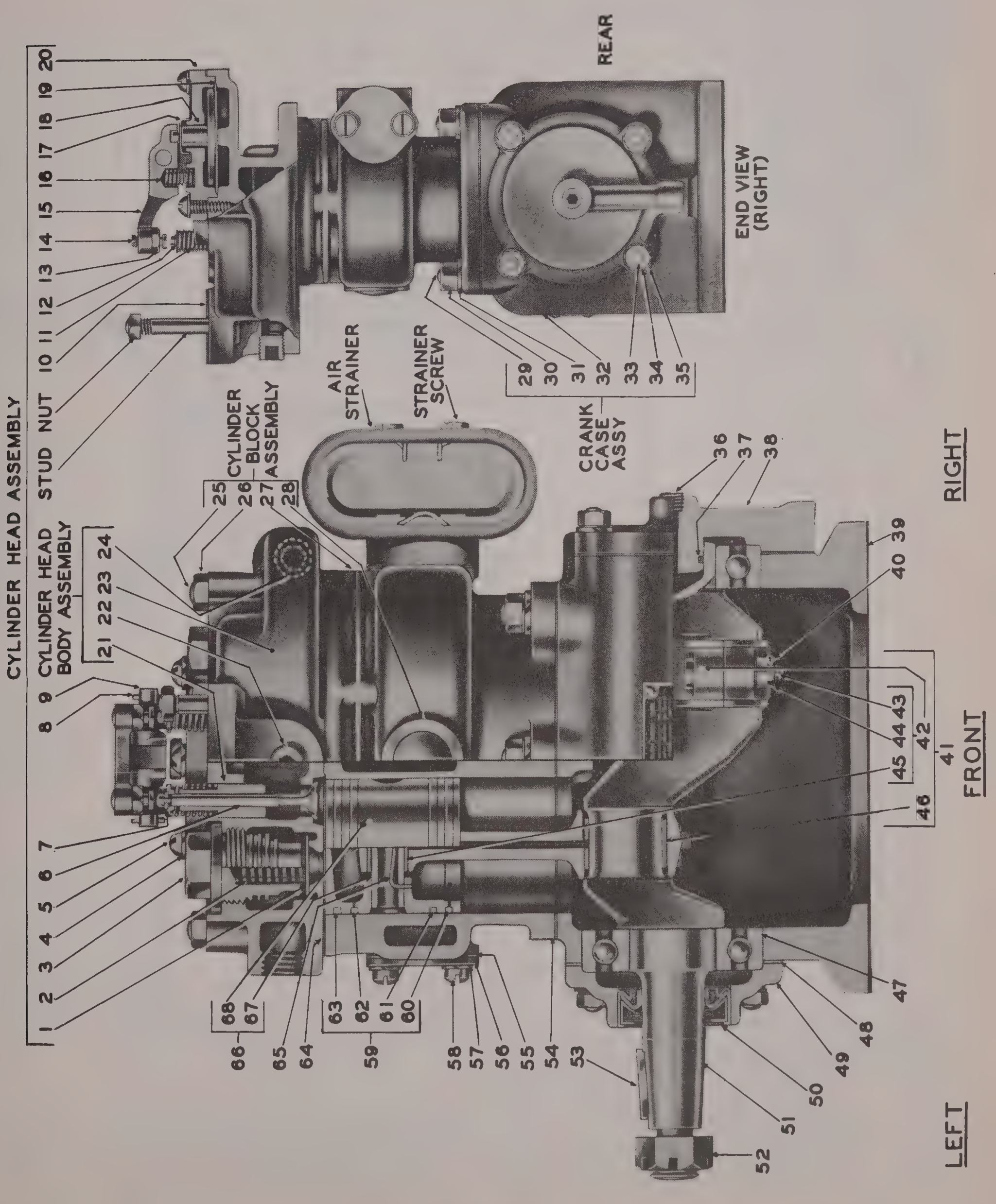

℄ OF CHASSIS
2 DIA. 10-SPLINES
15 7/8
10 3/4
9 3/8

SDD-UNIT

CATALOG 2 B 2

2-UE-7¼-VW COMPRESSORS

TWO CYLINDER - TYPE "U" - ENGINE LUBRICATED - 7¼ CUBIC FOOT - VERTICAL MOUNTING - WATER COOLED


CYLINDER HEAD ASSEMBLY
1
2
3
4
5
6
7
8
9
CYLINDER HEAD BODY ASSEMBLY
21
22
23
24
STUD
NUT
10
11
12
13
14
15
16
17
18
19
20
CYLINDER BLOCK ASSEMBLY
25
26
27
28
AIR STRAINER
STRAINER SCREW
REAR
END VIEW (RIGHT)
CRANK CASE ASSY
29
30
31
32
33
34
35
36
37
38
RIGHT
39
40
41
42
43
44
45
46
FRONT
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
LEFT

June, 1948

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO.

GENERAL OFFICES AND PLANT— ELYRIA, OHIO.
PACIFIC DIVISION— BERKELEY 2, CALIFORNIA.

2-UE-7¼-VW COMPRESSORS

TWO CYLINDER - TYPE "U" - ENGINE LUBRICATED - 7¼ CUBIC FOOT - VERTICAL MOUNTING - WATER COOLED

COMPRESSOR	Cylinder Head Assembly	Cylinder Head Body Assembly	*CYLINDER HEAD POSITION*	*DISCHARGE PORT POSITION*	Stud *In Head 2 Req'd*	Nut *For Head Studs*	Cylinder Block Assembly	*CYLINDER BLOCK POSITION*	Crankcase Assembly	Air Strainer			Strainer Screws *2 Req'd*
Pc.No.	Pc.No.	Pc.No.			Pc.No.	Pc.No.	Pc.No.		Pc.No.	Pc.No.	*Location*	*Facing*	Pc.No.
221948	222394	222390	OPPOSITE	REAR	212339	203145	215778	OPPOSITE	217294	215419	RIGHT	FRONT	203426
A 222576	222393	222389	OPPOSITE	REAR	203138	203145	215778	OPPOSITE	217294	215419	RIGHT	FRONT	203426
223077	222394	222390	OPPOSITE	REAR	212339	203145	215453	AS SHOWN	217294	215299	REAR	DOWN	203375
B 223224	222393	222389	AS SHOWN	FRONT	203138	203145	215453	OPPOSITE	217294	NONE	--	--	NONE
223383	222394	222390	AS SHOWN	FRONT	212339	203145	215778	AS SHOWN	217294	215419	RIGHT	FRONT	203426
223714	223393	222389	OPPOSITE	REAR	203138	203145	215778	OPPOSITE	217294	NONE	--	--	NONE
C 224013	222394	222390	OPPOSITE	REAR	212339	203145	215778	OPPOSITE	217294	215299	FRONT	DOWN	203375
224021	222394	222390	OPPOSITE	REAR	212339	203145	215778	OPPOSITE	217294	215419	LEFT	FRONT	203426

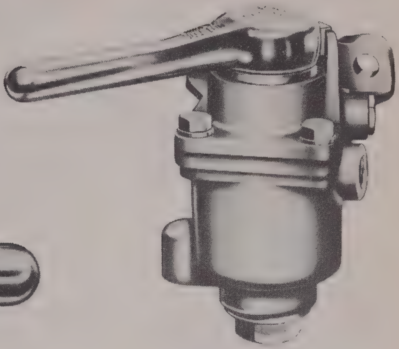
A - Substitute FLANGE GASKET, Pc.No. 213943, for Item No. 39 below; add DISCHARGE FITTING, Pc.No. 213042.
B - Less Item No. 39 below.
C - Substitute END COVER, Pc.No. 233598, for Item No. 38.

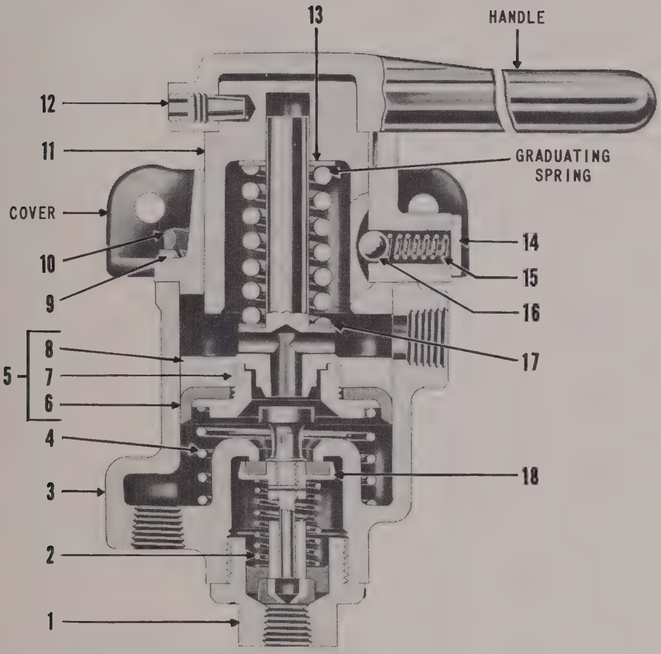
No.	Pc.No.	Quan.	Description
		1	**CYLINDER HEAD ASSEMBLY**
1	203102	2	Discharge Valve
2	210468	2	Discharge Valve Spring
3	210469	2	Discharge Valve Cap Nut
4	202981	5	Lock Washer
5	203114	5	Round Head Screw
6	231698	2	Unloader Valve
7	230578	2	Unloader Valve Stop
8	203016	2	Cotter Pin
9	203101	1	Lever Pin
10	204820	1	Discharge Fitting Gasket
11	203112	2	Unloader Valve Spring
12	230580	2	Spring Retaining Ring
13	202961	2	Lock Nut
14	202846	2	Adjusting Screw
15	215210	1	Lever
16	203113	1	Lever Spring
17	203106	1	Diaphragm Dust Guard
18	203108	1	Diaphragm Follower
19	203109	2	Diaphragms
20	203115	1	Diaphragm Box Cover
		1	**CYLINDER HEAD BODY ASSY**
21	230577	2	Unloader Valve Bushing
22	230065	1	Pipe Plug, 3/8"
23	212340	1	Cylinder Head Body
24	230576	1	Pipe Plug, 1/4"
		1	**CYLINDER BLOCK ASSEMBLY**
25	202999	2	Stud, 1 1/4"
	203000	4	Stud, 2 5/8"
26	203145	6	Nut
27	203448	1	Cylinder Block Body
28	202892	1	Welch Plug
		1	**CRANKCASE ASSEMBLY**
29	202998	6	Stud, 1 3/8"
30	203004	6	Nut
31	202983	6	Lock Washer
32	211375	1	Crankcase Body
33	202999	8	Stud, 1 1/4"
34	203145	8	Nut
35	202982	8	Lock Washer
36	230178	1	Pipe Plug, 1/8"
37	203028	1	Oil Seal Ring
38	230910	1	End Cover
39	211376	1	Flange Gasket
40	203016	4	Cotter Pin
41	216248	2	**CONNECTING ROD COMPLETE**
42	223070	2	CONN. ROD & CAP ASSY
43	202893	4	Bolt
44	203021	4	Nut
45	202988	2	Wrist Pin Bushing
46	232198	4	BEARING INSERT
47	SAE207	2	Ball Bearing
48	203052	2	End Cover Gasket
49	230528	1	End Cover
50	212735	1	Oil Seal
51	230527	1	Crankshaft
52	203571	1	Nut
53	211347	1	Key
54	202898	1	Cylinder Block Gasket
55	203242	3	Gasket
56	203243	2	Inlet Chamber Cover
57	202981	6	Lock Washer
58	203376	4	Cap Screw
59	222462	1	**PISTON RING SET**
60	232442	2	Oil Ring
	232439	2	Spiro-Seal Segment Ring
	232437	2	Expander Ring
61	232443	2	Compression Ring
62	232441	2	Scraper Ring
	232440	2	Segment Ring
	232438	2	Expander Ring
63	232443	2	Compression Ring
64	203462	1	Cylinder Head Gasket
65	202990	2	Wrist Pin Lock Wire
66	216174	2	**PISTON and WRIST PIN SET**
67	203449	2	Wrist Pin
68	203457	2	Piston

Revised
March, 1950

CATALOG 3 H 1

"HP" BRAKE VALVE





No.	Pc. No.	Quan.	Description
1	203266	1	CAP NUT
2	203265	1	INLET VALVE SPRING
3	203252	1	VALVE BODY
4	203253	1	PISTON RETURN SPRING
5	215305	1	PISTON ASSEMBLY
6	203525	1	PISTON CUP
7	203256	1	PISTON FOLLOWER
8	203254	1	PISTON
9	202982	4	LOCK WASHER
10	202979	4	CAP SCREW
11	203257	1	SPRING CAGE
12	203260	1	SET SCREW
13	203268	1	WASHER
14	203345	1	LOCK SPRING PLUG
15	204185	1	LOCK SPRING
16	201327	1	STEEL BALL
17	203764	*	SHIM, .0156″
	213696	1	SHIM, .063″
18	215306	1	INLET-EXHAUST VALVE ASSEMBLY

** As Required*

January, 1951

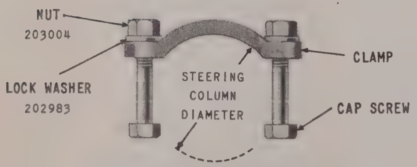
This Catalog supersedes Catalog 3-H-1 printed May, 1948.

"HP" BRAKE VALVE

BRAKE VALVE Pc. No.	Cover Pc. No.	Graduating Spring Pc. No.	Handle Pc. No.	Clamp *See Below* Pc. No.	*FOR STEERING COLUMN DIAMETER.*	*DELIVERY PORT POSITION FIGURE*
HP BRAKE VALVE - *with* HANDLE - *with* STEERING COLUMN CLAMP						
215747	203258	203269	203259	203878	2"	1
215748	203317	203269	203259	203454	2 1/4"	1
224181	203317	203269	233802	203454	2 1/4"	1
224649	203317	203269	233802	203454	2 1/4"	1
HP BRAKE VALVE - *with* HANDLE - *less* STEERING COLUMN CLAMP						
215304	203258	203269	203259	NONE	2"	1
215356	203317	203269	203259	NONE	2 1/4"	1
A 217454	203258	211802	203259	NONE	2"	1
222597	203258	203269	203259	NONE	2"	2
HP BRAKE VALVE - *less* HANDLE - *with* STEERING COLUMN CLAMP						
221754	203317	203269	NONE	203454	2 1/4"	1
HP BRAKE VALVE - *less* HANDLE - *less* STEERING COLUMN CLAMP						
220905	203258	203269	NONE	NONE	2"	1
222703	203317	203269	NONE	NONE	2 1/4"	1
HP BRAKE VALVE - *with* SCREW TYPE HANDLE - *with* STEERING COLUMN CLAMP						
B 217823	203317	203269	212547	203454	2 1/4"	1

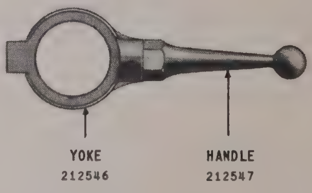
A - Substitute WASHER, 211803, for Item No. 13.
B - Add YOKE, 212546 (See illustration below).

CLAMP
and Related Parts



CLAMP Pc. No.	Cap Screw Pc. No.	*STEERING COLUMN DIAMETER*
203878	203410	2"
203454	203879	2 1/4"

SCREW TYPE HANDLE
with YOKE



DELIVERY PORT POSITIONS

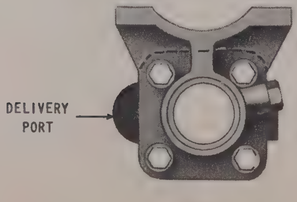


FIGURE 1

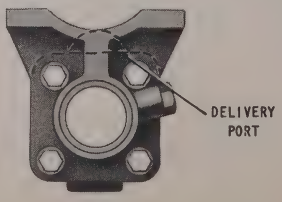
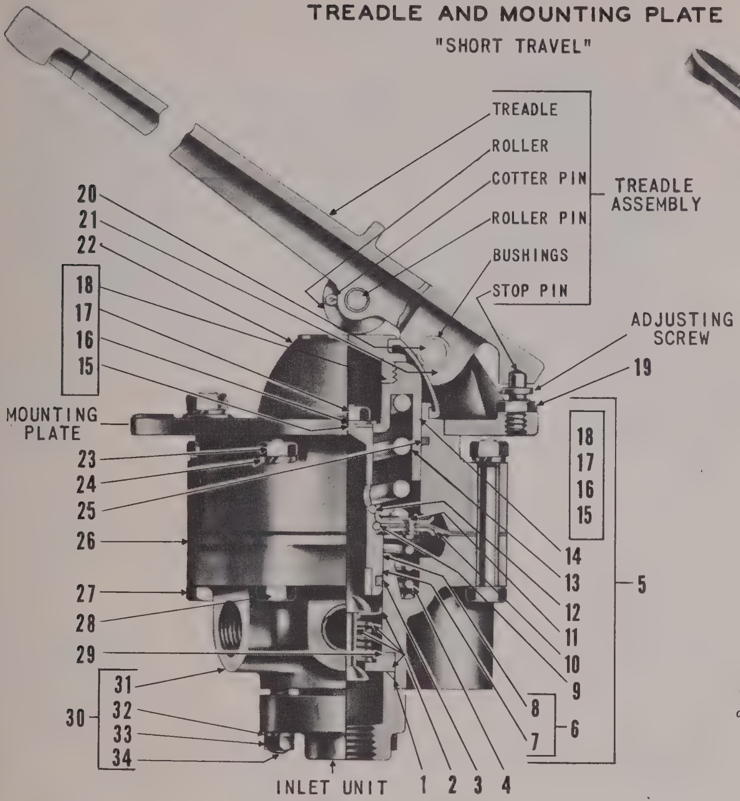


FIGURE 2

CATALOG 3 D 11

D-1 BRAKE VALVE
TREADLE AND MOUNTING PLATE
"SHORT TRAVEL"


TREADLE
ROLLER
COTTER PIN
ROLLER PIN
BUSHINGS
STOP PIN
TREADLE ASSEMBLY
ADJUSTING SCREW
19
20
21
22
18
17
16
15
MOUNTING PLATE
23
24
25
26
27
28
29
30
31
32
33
34
INLET UNIT
1
2
3
4
18
17
16
15
14
13
12
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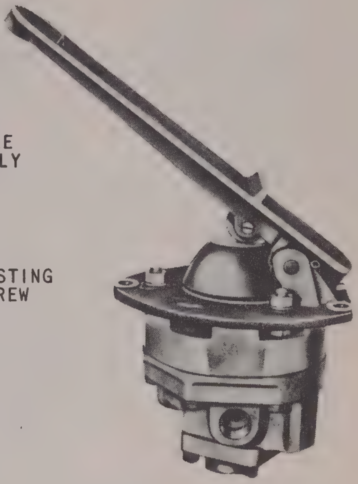
5



NOTE

"Short Travel" D-1 Brake Valves are stamped "S" on the Upper Body.

No.	Pc.No.	Quan.	Description
1	230878	1	GROMMET
2	221958	1	INLET VALVE ASSEMBLY
3	230895	1	GROMMET
4	230880	1	DIAPHRAGM RETURN SPRING
5	223180	1	**DIAPHRAGM & SPRING ASSEMBLY**
6	221963	1	PLUNGER ASSEMBLY
7	230882	1	VALVE SEAT
8	230881	1	PLUNGER
9	231008	1	GROMMET
10	221964	1	DIAPHRAGM ASSEMBLY
11	230887	*	SHIM, .010"
	230888	*	SHIM, .0031"
12	204149	1	RETAINING RING
13	232576	1	GRADUATING SPRING
14	232713	1	SPRING CAGE
15	230891	*	SHIM, .010"
	230892	*	SHIM, .0031"
16	230893	1	WASHER
17	203545	1	NUT
18	230894	1	CAP
19	230903	1	LOCK NUT
20	230908	1	TREADLE PIN
21	210067	1	COTTER PIN
22	230900	1	BOOT
23	203145	9	NUT
24	202982	9	LOCK WASHER
25	230897	1	GROMMET
26	230896	1	UPPER BODY
27	230899	3	CAP SCREW, 2 7/8"
28	230898	3	CAP SCREW, 2 1/8"
29	230872	*	SHIM, .010"
	230873	*	SHIM, .0031"
30	221962	1	**LOWER BODY ASSEMBLY**
31	230870	1	LOWER BODY
32	202981	3	LOCK WASHER
33	203147	3	NUT
34	230871	3	STUD

** As Required*

June, 1950

This Catalog supersedes Catalog 3-D-11 printed October, 1948.

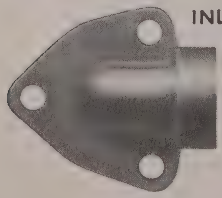
D-1 BRAKE VALVE
TREADLE AND MOUNTING PLATE
"SHORT TRAVEL"

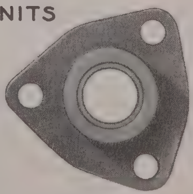
BRAKE VALVE Pc.No.	Treadle Assembly Pc.No.	Mounting Plate Pc.No.	Adjusting Screw Pc.No.	Inlet Unit		*INLET PORT POSITION*	*EXHAUST PORT POSITION*	*SUPERSEDES 'LONG TRAVEL' D-1 BRAKE VALVE* Pc.No.
				Inlet Body Pc.No.	Inlet Elbow Pc.No.			
D-I BRAKE VALVES *WITH* TREADLE, *WITH* MOUNTING PLATE								
223252	223255	230901	232419	230879	--	4	E	--
A&B 223329	221960	230901	233326	230879	--	4	E	--
223349	221960	230901	232419	230879	--	4	A	221956
223485	223013	230901	232419	230879	--	4	A	222995
223486	221961	230901	232419	230879	--	4	A	221957
223507	221960	230901	232419	230879	--	4	E	222851
223508	221961	230901	232419	230879	--	4	E	223108
223509	221960	230901	232419	230879	--	4	F	223397
223524	221960	230901	232419	--	231983	1	A	222692
223525	222883	230901	232419	230879	--	4	A	222871
223536	221960	230901	232419	--	231983	3	A	--
223696	221960	230901	232419	230879	--	4	B	--
B 224003	224002	230901	233326	230879	--	4	E	--
D-I BRAKE VALVE *LESS* TREADLE, *WITH* MOUNTING PLATE *(Omit Treadle Pin and Cotter Pin for Treadle - Item No's 20 and 21)*								
223510	NONE	230901	232419	230879	--	4	A	222328
D-I BRAKE VALVES *LESS* TREADLE, *LESS* MOUNTING PLATE *(Omit Treadle Pin and Cotter Pin for Treadle and Lock Nut - Item No.'s 19, 20, and 21)*								
223192	NONE	NONE	NONE	230879	--	4	A	222145
223503	NONE	NONE	NONE	230879	--	4	F	222848
223511	NONE	NONE	NONE	--	231983	2	A	--

A - Superseded by BRAKE VALVE, Pc.No. 224003 - Listed for parts service only.
B - Substitute three (3) CAP SCREWS, Pc.No. 232934, for Item No. 27; Add: MOUNTING PLATE SPACER, Pc.No. 232933.

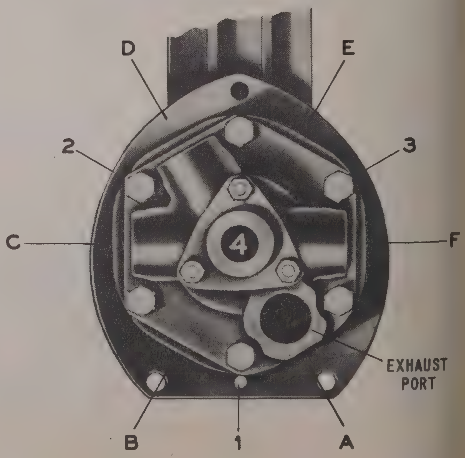
TREADLE ASSEMBLY Pc.No.	Treadle Pc.No.	Cotter Pins (2) Pc.No.	Roller Pin Pc.No.	Roller Pc.No.	Bushing (2) Pc.No.	Stop Pin Pc.No.
221960	230904	231664	231677	211026	230906	230907
221961	230905	231664	231677	211026	230906	230907
222883	232211	231664	231677	211026	230906	230907
223013	230904	231664	231677	231786	230906	230907
223255	232729	231664	231677	211026	230906	230907
224002	233592	231664	231677	211026	230906	230907

INLET UNITS


INLET ELBOW
Pc.No. 231983


INLET BODY
Pc.No. 230879

PORT POSITIONS



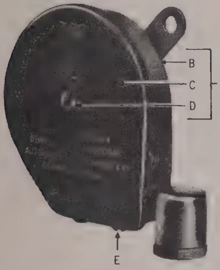
BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO.

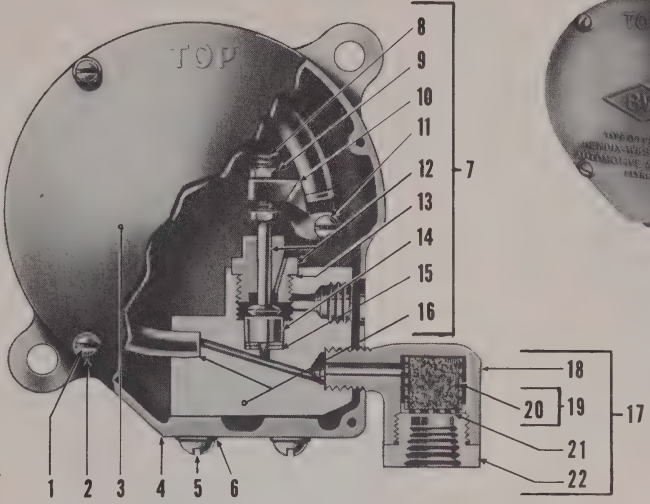
GENERAL OFFICES AND PLANT— ELYRIA, OHIO. PACIFIC DIVISION— BERKELEY 2, CALIFORNIA.

TYPE O-1 GOVERNORS

CATALOG 4 A 1

Governors may be equipped with Stamped Steel or Die-Cast Case and Cover under the same piece number for the complete Unit.





TOP
B-W
TYPE O-1 GOVERNOR
BENDIX-WESTINGHOUSE
AUTOMOTIVE AIR BRAKE CO.
ELYRIA, OHIO

Governors with Stamped Steel Case and Cover use the following parts to replace item No.'s 1 through 6 in parts list below:

A	221164	(1)	CASE & COVER ASSY.
B	221163	(1)	Stamped Steel Case
C	214471	(1)	Stamped Steel Cover
D	232964	(1)	Screw with Washer
E	232964	(4)	Screw with Washer

TYPE O-I GOVERNOR

Pc.No. 215011

(With Strainer - Less Fittings)

No.	Pc.No.	Quan.	Description
1	204875	4	MACHINE SCREW
2	201556	4	LOCK WASHER
3	201523	1	DIE-CAST COVER
4	201522	1	DIE-CAST CASE
5	204874	4	MACHINE SCREW
6	201543	4	LOCK WASHER
7	205470	1	BODY ASSEMBLY
8	201521	1	ADJUSTING SCREW
9	210564	1	BRASS NUT
10	201520	1	ADJUSTING SCREW BRACKET
11	210563	1	SCREW
12	217221	1	**UPPER VALVE & GUIDE ASSEMBLY
13	201552	*	SHIM
14	201518	1	LOWER VALVE
15	201769	1	PISTON SPRING
16	205471	1	BODY AND TUBE
17	205115	1	STRAINER ASSEMBLY
18	201780	1	BODY
19	216627	1	STRAINER
20	200100	1	STRAINER CYLINDER
21	200099	1	STRAINER CUP
22	202620	1	CAP NUT

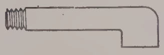
* *As many as required to obtain range setting.*

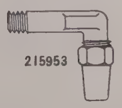
** *Guide is hand-reamed to fit Upper Valve. Guide and Valve are replaced as an assembly to insure proper service.*

Type O-1 Governors listed in schedule below consist of Governor (with Strainer), Pc.No. 215011, plus fittings listed for each Governor.

GOVERNOR	Upper Fitting		
Pc.No.	Connector Pc.No.	Elbow Pc.No.	*ELBOW FACES*
A 205520	205817	--	--
215639	205817	--	--
215799	215825	--	--
215995	--	215953	Down
216386	--	215953	Up
217053	--	211041	Down
220912	--	215953	Front

A-Include CONNECTOR, Pc.No. 205053, (located between Governor and Strainer).


211041


215953

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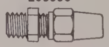

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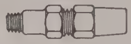

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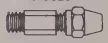
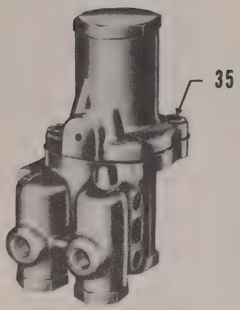


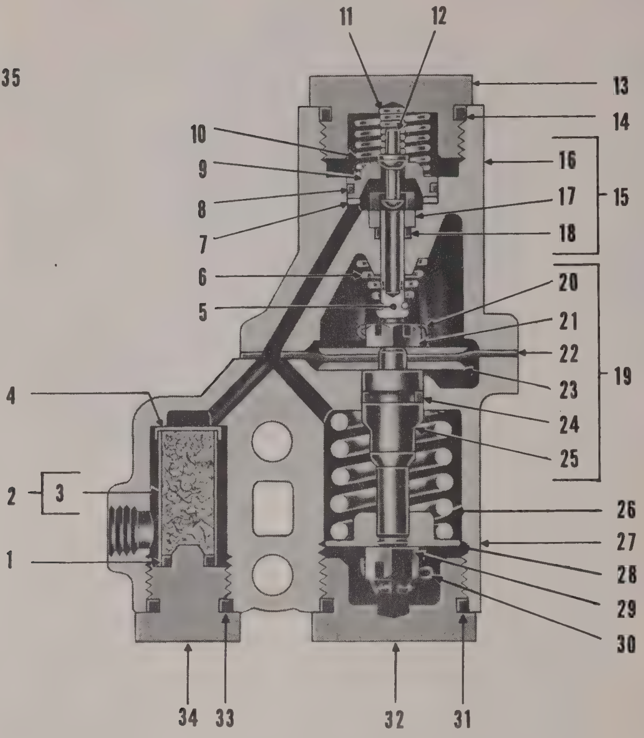
NOTE: The operating pressure range of Type O-1 Governors is 80-85 lbs. per square inch minimum and 100-105 lbs. per square inch maximum.

June, 1950

This Catalog supersedes Catalog 4-A-1 printed October, 1949

TYPE "D" GOVERNOR
PC. NO. 224333





TYPE "D" GOVERNOR
Pc. No. 224333

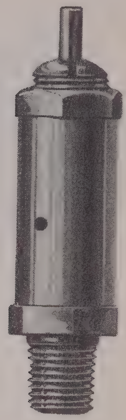
No.	Pc. No.	Quan.	Description
1	233492	2	FELT WASHER
2	224988	2	STRAINER ASSEMBLY
3	233966	2	STRAINER CYLINDER
4	200099	2	STRAINER CUP
5	233481	1	EXHAUST STEM
6	210002	1	EXHAUST STEM SPRING
7	212670	*	SHIM, .010"
	233958	*	SHIM, .003"
8	233959	1	GROMMET, .75" O.D. - .625" I.D.
9	233960	1	INLET VALVE SEAT
10	212609	1	SEAT RETAINING SPRING
11	233477	1	INLET VALVE SPRING
12	234699	1	INLET-EXHAUST VALVE
13	233489	1	VALVE BODY SCREW CAP
14	230789	1	GROMMET, 1.234" O.D.
15	224334	1	VALVE BODY COMPLETE
16	233957	1	VALVE BODY
17	233474	1	GUIDE BUSHING
18	232068	1	GROMMET, 5/16" O.D.
19	225188	1	DIAPHRAGM AND STEM ASSEMBLY
20	203372	1	COTTER PIN
21	233704	1	NUT
22	233964	1	DIAPHRAGM
23	233963	2	DIAPHRAGM FOLLOWER
24	214324	1	GROMMET, .504" O.D.
25	234929	1	DIAPHRAGM STEM
26	234899	1	PRESSURE SETTING SPRING
27	233961	1	SPRING CAGE
28	233488	1	SPRING SEAT
29	233965	1	ADJUSTING NUT
30	234695	1	COTTER PIN
31	230789	1	GROMMET, 1.234" O.D.
32	233489	1	SPRING CAGE SCREW CAP
33	212264	2	GROMMET, .75" O.D. - .5" I.D.
34	233491	2	STRAINER SCREW CAP
35	203376	4	CAP SCREW

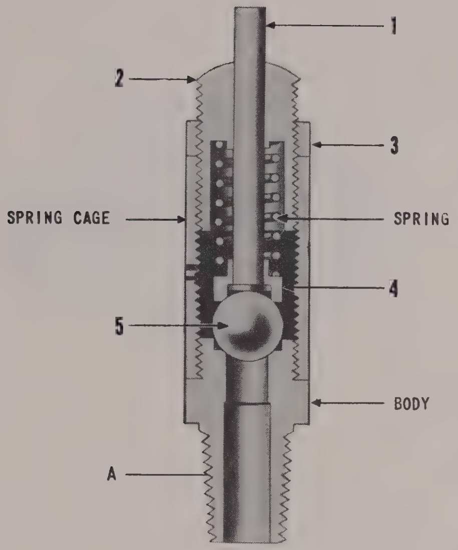
* *As required to obtain .030" to .034" inlet opening.*

July, 1952

CATALOG 4 D I

SAFETY VALVE





SAFETY VALVE Pc. No.	Body Pc. No.	Spring Pc. No.	Spring Cage Pc. No.	*PRESSURE SETTING**	A *PIPE THREAD*
205105	201609	201614	201610	150 ± 5#	1/4"
215057	201609	201614	201610	200 ± 5#	1/4"
217593	201609	201614	201610	85 TO 90#	1/4"
221154	201609	201614	201610	175 ± 5#	1/4"
221786	201609	201614	201610	100 TO 105#	1/4"
223444	232947	201614	201610	150 ± 5#	3/8"

**Pressure Setting Stamped on Body.*

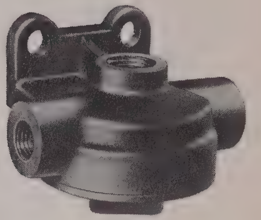
No.	Pc. No.	Quan.	Description
1	201613	1	Release Pin
2	201611	1	Adjusting Nut
3	201612	1	Lock Nut
4	201615	1	Spring Seat
5	213203	1	Steel Ball

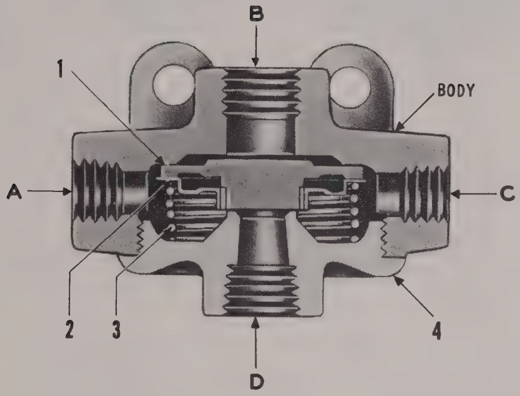
September, 1949

THIS CATALOG *supersedes Catalog 4-D-1 printed February, 1948.*

CATALOG 4 E I

QUICK RELEASE VALVE





QUICK RELEASE VALVE
WITH MOUNTING FLANGE

QUICK RELEASE VALVE Pc. No.	Body Pc. No.	PORT DIMENSIONS			
		A	B	C	D
205000	204847	1/4"	3/8"	1/4"	3/8"
221992	230931	1/4"	1/2"	1/4"	3/8"
224417	234072	3/8"	3/8"	3/8"	3/8"

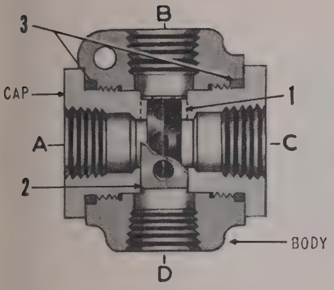
No.	Pc. No.	Quan.	Description
1	232017	1	DIAPHRAGM
2	202587	1	SPRING SEAT
3	202588	1	SPRING
4	211028	1	COVER

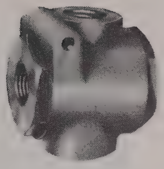
Current Quick Release Valves are furnished with the modified, flat-rim diaphragm which does not require a dampener.

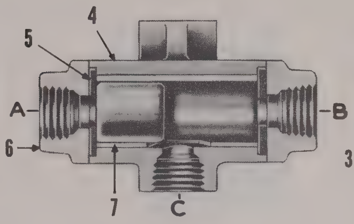
October, 1950

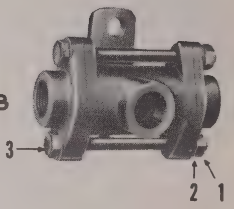
This Catalog supersedes Catalog 4-E-1 printed December, 1949.

CHECK VALVES









DOUBLE CHECK VALVES - DISC TYPE

DOUBLE CHECK VALVE Pc. No.	Body Pc. No.	Cap 2 Req'd. Pc. No.	*PIPE THREAD DIMENSIONS* A	B	C	D
220693	213647	213649	1/4"	1/4"	1/4"	1/4"
220694	213648	213650	3/8"	3/8"	3/8"	3/8"

No.	Pc. No.	Quan.	Description
1	232018	1	VALVE
2	213651	1	VALVE GUIDE
3	214398	2	GROMMET

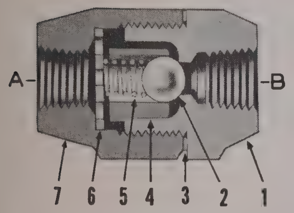
DOUBLE CHECK VALVE Pc. No.	Body Pc. No.	Cap 2 Req'd. Pc. No.	*PIPE THREAD DIMENSIONS* A	B	C	D
222097	231250	231254	1/2"	1/2"	1/2"	1/2"

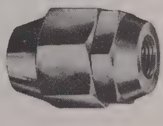
No.	Pc. No.	Quan.	Description
1	232318	1	VALVE
2	231251	1	VALVE GUIDE
3	213346	2	GROMMET

DOUBLE CHECK VALVE - SHUTTLE TYPE

SHUTTLE CHECK VALVE Pc. No.	*PIPE THREAD DIMENSIONS* A	B	C
217698	3/8"	3/8"	3/8"

No.	Pc. No.	Quan.	Description
1	203147	2	HEX NUT
2	203567	2	LOCK WASHER
3	212207	2	HEX HEAD BOLT
4	217697	1	BODY
5	210354	2	SEAL GASKET
6	212206	2	END CAPS
7	212205	1	SHUTTLE VALVE

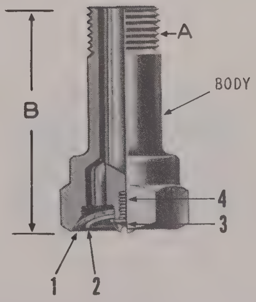




SINGLE CHECK VALVE - VERTICAL and HORIZONTAL

SINGLE CHECK VALVE Pc. No.	*PIPE THREAD DIMENSIONS* A	B
220306	1/4"	1/4"

No.	Pc. No.	Quan.	Description
1	213231	1	CAP NUT
2	213202	1	STEEL BALL
3	213234	1	GASKET
4	213232	1	BALL GUIDE
5	213235	1	SPRING
6	213236	1	SPRING SEAT
7	213237	1	BODY



EXHAUST CHECK VALVE

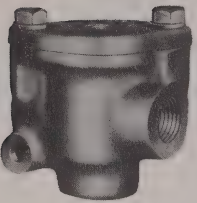
EXHAUST CHECK VALVE Pc. No.	Body Pc. No.	*PIPE THREAD DIMENSION* A	*LENGTH* B
221087	214231	3/8"	2 1/4"
224667	234255	1/2"	4 1/8"
224897	234473	3/4"	3"
225111	234828	1/2"	3"
225134	234869	1/4"	1 1/2"
225302	235016	3/8"	1 7/16"

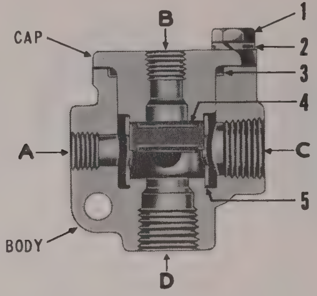
No.	Pc. No.	Quan.	Description
1	214232	1	DIAPHRAGM
2	214233	1	DIAPHRAGM WASHER
3	214234	1	LOCK WASHER
4	214235	1	DIAPHRAGM SCREW

November, 1952

This Catalog supersedes Catalog 4-H-1 printed January, 1950

CHECK VALVES

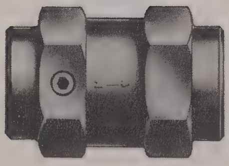


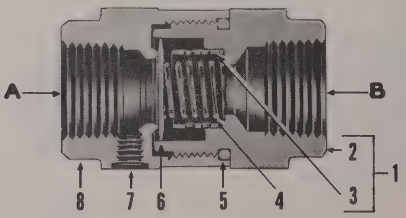


DOUBLE CHECK VALVE - SHUTTLE TYPE

DOUBLE CHECK VALVE Pc.No.	Cover Pc.No.	Body Pc.No.	*PIPE THREAD DIMENSIONS*			
			A	B	C	D
223868	233463	233461	1/4″	1/4″	1/2″	1/2″
223869	233464	233462	1/2″	1/2″	1/2″	1/2″
223980	233463	233573	1/4″	1/4″	1/4″	1/4″
223981	233575	233574	3/8″	3/8″	3/8″	3/8″

No.	Pc.No.	Quan.	Description
1	203414	2	Cap Screw
2	202982	2	Lock Washer
3	233955	1	Grommet
4	233466	1	Valve
5	233465	1	Valve Guide





SINGLE CHECK VALVE

SINGLE CHECK VALVE Pc.No.	*PIPE THREAD DIMENSIONS*	
	A	B
223891	3/4″	3/4″

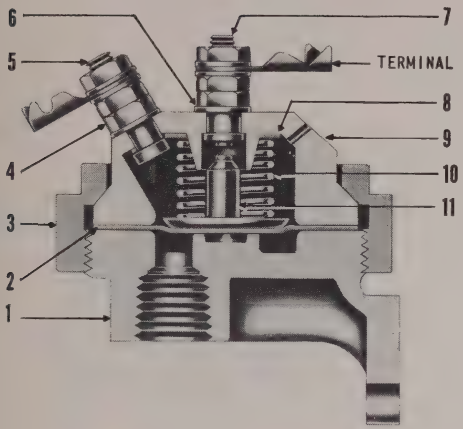
No.	Pc.No.	Quan.	Description
1	223892	1	BODY ASSEMBLY
2	233438	1	Body
3	233439	1	Valve Stop Bushing
4	233437	1	Spring
5	233955	1	Grommet
6	230935	1	Discharge Valve
7	233008	1	Pipe Plug, 1/16″
8	233436	1	Cap Nut

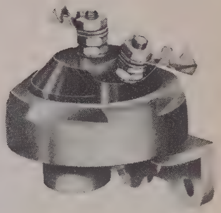
This Catalog supersedes Catalog 4-H-1B printed January, 1950.

CATALOG 4 J 2

STOP LIGHT SWITCHES

TYPE SL-2





STANDARD TYPE SL-2 STOP LIGHT SWITCHES

STOP LIGHT SWITCH Pc. No.	Terminal 2 Req'd Pc. No.	*CONTACT PRESSURE* *Maximum* *Lbs. per Sq. In.*	*OUTER TERMINAL POSITION*
223220	203063	5	DIAGRAM #1
223222	203063	5	DIAGRAM #2
223665	NONE	5	DIAGRAM #1

No.	Pc. No.	Quan.	Description
1	232683	1	BODY
2	232686	1	DIAPHRAGM
3	232685	1	COVER NUT
4	203059	6	NUT
5	203623	1	TERMINAL SCREW
6	203058	6	WASHER
7	215959	1	TERMINAL SCREW
8	233280	1	CONNECTOR
9	232684	1	COVER
10	232687	1	SPRING
11	223221	1	CONTACT PLUNGER

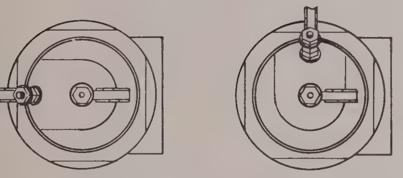
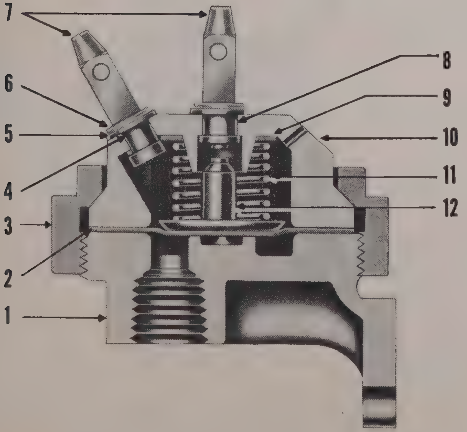


DIAGRAM #1 DIAGRAM #2

OUTER TERMINAL POSITION



TYPE SL-2 STOP LIGHT SWITCH with CLIP TERMINALS

STOP LIGHT SWITCH Pc. No.	*CONTACT PRESSURE* *Maximum* *Lbs. per Sq. In.*	*OUTER TERMINAL POSITION*
223871	5	DIAGRAM #1

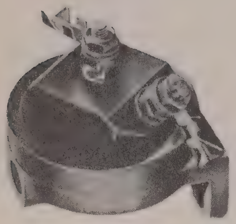
No.	Pc. No.	Quan.	Description
1	232683	1	BODY
2	232686	1	DIAPHRAGM
3	232685	1	COVER NUT
4	213379	1	TERMINAL SCREW
5	203058	2	WASHER
6	213373	2	SHAKE-PROOF WASHER
7	220519	2	CLIP TERMINAL
8	220520	1	TERMINAL SCREW
9	233280	1	CONNECTOR
10	232684	1	COVER
11	232687	1	SPRING
12	223221	1	CONTACT PLUNGER

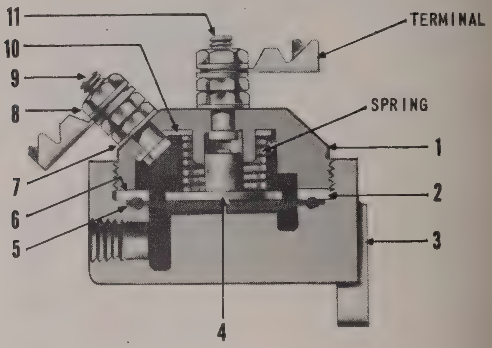
August, 1951

This Catalog supersedes Catalog 4-J-2 printed May, 1949.

STOP LIGHT SWITCHES

TYPE SL-1



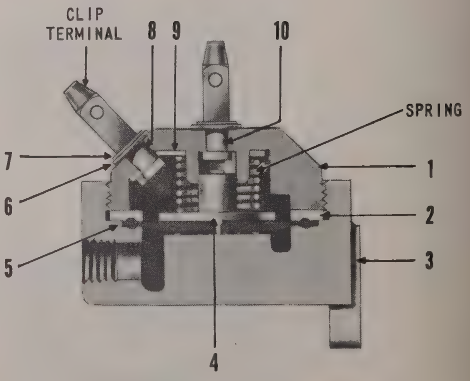


STANDARD TYPE SL-I STOP LIGHT SWITCHES

STOP LIGHT SWITCH Pc. No.	Spring Pc. No.	Terminal *2 Req'd* Pc. No.	*CONTACT PRESSURE Maximum Lbs. per Sq. In.*
215537	203620	203063	5
217192	211170	203063	10
222136	203620	NONE	5

No.	Pc. No.	Quan.	Description
1	203621	1	COVER
2	203382	1	DIAPHRAGM RING
3	203380	1	BODY
4	215538	1	CONTACT PLUNGER
5	203381	1	DIAPHRAGM
6	213873	*1	SHIM WASHER
7	203058	6	TERMINAL WASHER
8	203059	6	TERMINAL NUT
9	203623	1	TERMINAL SCREW
10	203622	1	TERMINAL CONNECTOR
11	215959	1	TERMINAL SCREW

* *Use if required to obtain contact pressure.*



TYPE SL-I STOP LIGHT SWITCH with CLIP TERMINALS

STOP LIGHT SWITCH Pc. No.	Spring Pc. No.	Terminal *2 Req'd* Pc. No.	*CONTACT PRESSURE Maximum Lbs. per Sq. In.*
220516	203620	220519	5

No.	Pc. No.	Quan.	Description
1	203621	1	COVER
2	203382	1	DIAPHRAGM RING
3	203380	1	BODY
4	215538	1	CONTACT PLUNGER
5	203381	1	DIAPHRAGM
6	203058	2	WASHER
7	213373	2	LOCK WASHER
8	213379	1	TERMINAL SCREW
9	203622	1	TERMINAL CONNECTOR
10	220520	1	TERMINAL SCREW

This Catalog supersedes Catalog 4-J-1 printed April, 1948.

August, 1951

VENDOR: American Chain & Cable Co.

65-D-00550

EMERGENCY BRAKE

ART NO.	DESCRIPTION	NO. REQ.
-532	Arm - Brake Lever - Front R.H. C-532-A	1
-531	Arm - Brake Lever - Front L.H. C-531-A	1
-530	Arm - Brake Lever - Rear R.H. C-530-A	1
-529	Arm - Brake Lever - Rear L.H. C-529-A	1
	C-598-1 Bushing, (Two included in each Brake Lever Arm) Oiless	
-524	Pin - Brake Anchor S.A.E. 1020	8
-512-1	Screw - Lock 5/16 In. - 18 Cone	4
-499	Nut - Hex. 5/16 In. - 18 Hex.	4
A-533	Brake Shoe & Lining Assembly	4
	C-533 - Shoe Brake C-533-A	4
	C-33 - Lining - Brake C-888	4
	C-91 - Rivet 7 - 8	32
	C-598-3 - Bushing (Two assemblies in each C-533 Shoe) Steel	8
-522	Pin - Brake Shoe S.A.E. 1020	4
-534	Retainer - Brake Shoe Pin .093 In. x 1-3/8 In. - .088#	4
-535	Screw - Cap 5/16 In. - 18 x 5/8 In.	4
-536	Washer - Lock 5/16 In. Std.	4
-521	Rod - Brake Lever Arm Tie Forging	2
-537	Lever - Brake Operating C-537-A	2
A-12-7	Pin - Clevis 5/8 In. - S.A.E. Std.	4
-246	Pin - Cotter 1/8 In. x 1 In.	4
-523	Spring - Brake Release X-1065	2
-538	Washer - Plain 3/4 In. - S.A.E. Std.	4
-539	Nut - Spherical 1-5/16 In. Hex. Stock	2
-540	Nut - Hex. 5/8 In. - 18 Hex.	2
-514	Spring - Brake Shoe X-1065	2
-604	Screw - Brake Shoe Adjusting 3/8 In. - 16 Cone	4
-541	Nut - Hex. 3/8 In. - 16 Hex.	4
-548-1	Bracket - Brake Anchor R.H. C-548-A	1
-549	Bracket - Brake Anchor L.H. C-549-A	1
-472-2	Decalcomania	2
ML:CC	6-25-35	
N-B-933(E)	9-1-44, Revised and rewritten	
	HOOK-UP PARTS	
A-565	Bracket - Brake Cross Shaft	
	C-565 Bracket - Brake Cross Shaft C-565-A	2
	C-954 Fitting - Grease	2
-570-2	Shaft - Brake Cross 1-1/4 In. x 23-1/4 In. CRS	1
-413	Lever - Brake Cross Shaft C-351-A	1
-351	Lever - Brake Cross Shaft C-351-A	2
-356	Key - Woodruff #12	3

VENDOR: American Chain & Cable Co.	PARTS LIST 65-D-00550 EMERGENCY BRAKE

PART NO.	DESCRIPTION	NO. REQ.
C-16	Bolt - Hex. Head 3/8 In. - 24 x 1-7/8 In.	3
C-15	Nut - Hex. 3/8 In. - 24	3
C-17	Washer - Lock 3/8 S.A.E. Std.	3
RA-12-6	Pin - Clevis 1/2 In. S.A.E. Std.	4
C-354	Yoke - Adjustable 1/2 In. S.A.E. Light	2
C-1052	Rod - Cross Shaft to Brake Forging	2
C-270	Nut - Hex. 1/2 In. - 20	2

VENDOR: Lipe-Rollway Corporation	14" Cover Plate Assembly 140-1-315

PART NO.	DESCRIPTION	NO. REQ.
AC2-70	Flywheel Ring & Stud Assembly	1
X21-12	Flywheel Ring Stud	4
C1-61	Pressure Plate	1
C3-25	Adjusting Plate	1
C4-28	Sleeve	1
C5-4	Pressure Spring	1
C6-2	Retractor Spring	4
C7-2	Spring Retainer Pin	4
C8-21	Pressure Lever	20
C10-2	Adjusting Strap	4
C11-4	Snap Ring	1
C13-7	Fulcrum Ring	2
C20-1	Adjusting Shim	28
C37-2	Spring Equalizer Ring	1
X4-20	Flywheel Ring Stud Nut	4
X10-23	Flywheel Ring Stud Nut Lockwasher	4
X17-7	Lever Locking Ball	20

PARTS LIST

VENDOR: Lipe-Rollway Corporation	DISC ASSEMBLY 140-6-451

PART NO.	DESCRIPTION	NO. REQ.
K-50	Facing Kit	1

VENDOR: Hendrickson Motor Truck Company	CE-6047 FUEL TANK

PART NO.	DESCRIPTION	NO. REQ.
CE-6047	43 Gal. capacity fuel tank	1
AE-5614	Forward Mnt'g. Brk't.	1
BE-5613	Rear Mnt'g. Brk't.	1
AE-3280	Stand Pipe	1
439059-L9	Fuel Gauge sender unit (Stewart Warner)	1

VENDOR: International Harvestor Company

Red Diamond #406

ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	ENGINE AND CLUTCH	
90281R91	ENGINE WITHOUT FUEL AND ELECTRICAL EQUIPMENT	1
90287R91	TRIM KIT FUEL AND ELECTRICAL EQUIPMENT	1
136727HB	GASKET SET CYL HEAD OVERHAUL	1
26126H0	GASKET CARBURETOR TO MANIFOLD	2
61977H	GASKET CARBURETOR TO MANIFOLD	2
82924R1	GASKET CARBURETOR TO MANIFOLD	2
118714H	GASKET CARBURETOR TO MANIFOLD	2
61483HB	GASKET CYLINDER HEAD	1
61488H	GASKET CYLINDER HEAD COVER	1
16075D	GASKET CYLINDER HEAD COVER NUT	4
61499H	GASKET EXH TO INTAKE MANIFOLD	1
118717H	GASKET EXH TO INTAKE MANIFOLD	1
54948HA	GASKET EXHAUST MANIFOLD EXPANSION CLAMP	2
82928R1	GASKET INTAKE MANF TO CYL HD	1
82927R1	GASKET MANIFOLDS TO CYL HEAD	2
61482H	GASKET VALVE LIFTER ROD COVER	1
16074D	GASKET WATER OUTLET HOSE CONN TO CYLINDER HEAD	1
16075D	GASKET WATER PUMP SUPPORT LUG	1
16073DA	GASKET WATER PUMP TO CYL HEAD	1
118700H	GASKET SET ENGINE LOWER CRANKCASE OVERHAUL	1
120575H	GASKET AIR COMPRESSOR MTG BRKT TO CRANKCASE PLATE	1
83810HA	GASKET AIR COMPRESSOR MTG BRKT TO PLATE	1
83817HA	GASKET AIR COMPRESSOR TO MOUNTING BRACKET	1
62275VA	GASKET CAMSHAFT REAR BEARING COVER PLATE	1
34579HA	GASKET CRKSHFT REAR BRG OIL SEAL LOWER RETAINER	2
16122DA	GASKET CRKSHFT REAR BRG OIL SEAL UPPER RETAINER	1
16016D	GASKET FLYWHEEL HSG TO CRKCSE	1
16786D	GASKET FUEL PUMP TO CRANKCASE	1
16170D	GASKET GEAR CASE COVER PLATE TO CRANKCASE	1

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
54648H	GASKET GEAR CASE COVER TO PLT	1
26719HB	GASKET OIL FILTER TO CRKCSE	1
160850A	GASKET OIL PAN FRONT	1
130521H	GASKET OIL PAN LEFT	1
161080B	GASKET OIL PAN REAR	1
130520H	GASKET OIL PAN RIGHT	1
118692H	GASKET OIL PUMP TO CRANKCASE	1
33688H	SEAL OIL CRKSHFT REAR BRG CAP FELT	2
39783H	WASHER DISTR TO BRKT CORK	1
139142HBX	CRANKCASE W/BEARING CAPS ASM	1
72989R1	GASKET OIL COOLER MTG PAD COVER PLATE	1
115093	WASHER LOCK 3/8 MED	2
63556R1	PLUG EXPANSION 2 INCH	3
126045	PLUG PIPE CTSK 3/8 CRANKCASE FRONT	1
126045	PLUG PIPE CTSK 3/8 CRANKCASE REAR	1
126045	PLUG PIPE CTSK 3/8 CRANKCASE SIDE	
103883	PLUG PIPE SLT HD 1/8 CRANKCASE	2
103865	PLUG PIPE SQ HD 1/8 CRANKCASE	3
103868	PLUG PIPE SQ HD 1/2 CRANKCASE	
61440H	SLEEVE CYLINDER STD SIZE OD	6
56435R1	SLEEVE CYL 010 O/S OD	6
59354R1	SLEEVE CYL 015 O/S ID	6
54267R1	SLEEVE CYL 030 O/S OD	6
61487HBX	COVER CYL HEAD ASM	1
61483HB	GASKET CYL HEAD	1
61488H	GASKET CYL HEAD COVER	1
83413R91	HEAD CYL W/VALVES ASM	1
82917R11	HEAD CYLINDER W/VALVE GUIDES ASM	1
118643HA	BOLT CYL HEAD LONG	10
118641HA	BOLT CYL HEAD OIL	1
118642HA	BOLT CYL HEAD SHORT	12
52726R1	WASHER CYL HEAD BOLT	22
65377R1	NUT CYLINDER HEAD COVER	4
25170H	NUT CYLINDER HEAD COVER	*
131486	NUT LOW CROWN 3/8NF CYLINDER HEAD COVER NUT	*
103867	PLUG PIPE SQ HD 3/8 CYLINDER HEAD	2

VENDOR: International Harvester Company

Red Diamond #406

ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	ENGINE AND CLUTCH	
82930R1	TUBE CYL HD SEAL	6
160750	WASHER CYL HD COVER FIBER	4
118775	WASHER FLAT 3/8 CYLINDER HEAD COVER	4
118609HAX	BEARING CRKSHFT FRT STD 118609HA AND 118612HA	1
134405HAX	BEARING CRKSHFT FRT 002 U/S 134405HA AND 134440HA	1
135141HAX	BEARING CRKSHFT FRT 010 U/S 135141HA AND 135142HA	1
125698HAX	BEARING CRKSHFT FRT 020 U/S 125697HA AND 125698HA	1
118610HAX	BEARING CRKSHFT FRT 030 U/S 118610HA AND 118613HA	1
137114HAX	BEARING CRKSHFT FRT 040 U/S 137114HA AND 137735HA	1
118611HAX	BEARING CRKSHFT FRT 060 U/S 118611HA AND 118614HA	1
118616HAX	BEARING CRKSHFT INTER STD 118616HA AND 118619HA	5
134406HAX	BEARING CRKSHFT INTER 002 U/S 134406HA AND 134441HA	5
135143HAX	BEARING CRKSHFT INTER 010 U/S 135143HA AND 135144HA	5
125700HAX	BEARING CRKSHFT INTER 020 U/S 125699HA AND 125700HA	5
118617HAX	BEARING CRKSHFT INTER 030 U/S 118617HA AND 118620HA	5
137115HAX	BEARING CRKSHFT INTER 040 U/S 137115HA AND 137736HA	5
118618HAX	BEARING CRKSHFT INTER 060 U/S 118618HA AND 118621HA	5
118623HAX	BEARING CRKSHFT REAR ASM STD 1-118623HA 10118626HA AND 4-118629H	1
134407HAX	BEARING CRKSHFT REAR 002 U/S 1-134407HA 1-134442HA AND 4-118629H	1
135145HAX	BEARING CRKSHFT REAR 010 U/S 1-135145HA 1-135146HA AND 4-118629H	1

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
125702HAX	BEARING CRKSHFT REAR 020 U/S 1-125701HA 1-125702HA AND 4-118629H	1
118624HAX	BEARING CRKSHFT REAR 030 U/S 1-118624HA 1-118627HA AND 4-118629H	1
137116HAX	BEARING CRKSHFT REAR 040 U/S 1-137116HA 1-137737HA AND 4-118629H	1
118625HAX	BEARING CRKSHAFT REAR 060 U/S 1-118625HA 1-118628HA AND 4-118629H	1
133272HA	BEARING SET CRANKSHFT STD	1
118609HAX	BEARING CRKSHFT FRONT	1
118616HAX	BEARING CRKSHFT INTER	5
118623HAX	BEARING CRKSHFT REAR	1
137111HA	BEARING SET CRKSHFT 002 U/S	1
134405HAX	BEARING CRKSHFT FRONT	1
134406HAX	BEARING CRKSHFT INTER	5
134407HAX	BEARING CRKSHFT REAR	1
135147HA	BEARING SET CRKSHFT 010 U/S	1
135141HAX	BEARING CRKSHFT FRONT	1
135143HAX	BEARING CRKSHFT INTER	5
135145HAX	BEARING CRKSHFT REAR	1
133273HA	BEARING SET CRKSHFT 020 U/S	1
125698HAX	BEARING CRKSHFT FRONT	1
125700HAX	BEARING CRKSHFT INTER	5
125702HAX	BEARING CRKSHFT REAR	1
137112HA	BEARING SET CRKSHFT 030 U/S	1
118610HAX	BEARING CRKSHFT FRONT	1
118617HAX	BEARING CRKSHFT INTER	5
118624HAX	BEARING CRKSHFT REAR	1
137113HA	BEARING SET CRKSHFT 040 U/S	1
137114HAX	BEARING CRKSHFT FRONT	1
137115HAX	BEARING CRKSHFT INTER	5
137116HAX	BEARING CRKSHFT REAR	1
143301HA	BEARING SET CRKSHFT 060 U/S	1
118611HAX	BEARING CRKSHFT FRONT	1
118618HAX	BEARING CRKSHFT INTER	5
118625HAX	BEARING CRKSHFT REAR	1
118548HA	BOLT CRKSHFT BRG CAP	16
118608H	CAP CRKSHFT FRT BRG	1
118615H	CAP CRKSHFT INTER BRG	5
118622H X	CAP CRKSHFT REAR BRG ASM W/PINS	1
118528H	CRANKSHAFT STD SIZE	1
70363R1	CRANKSHAFT 010 U/S	1
70364R1	CRANKSHAFT 020 U/S	1

PARTS LIST

VENDOR: International Harvester Company	Red Diamond #406 ENGINE

IH PART NUMBER	DESCRIPTION	REQUIRED
	ENGINE AND CLUTCH	
118529H	CRANKSHAFT 030 U/S	1
71724R1	CRANKSHAFT 040 U/S	1
138012H	CRANKSHAFT 060 U/S	1
63024H	DAMPER VIBRATION	1
181111	BOLT HH 3/8 NCX7/8	6
115093	WASHER LOCK 3/8 MED	6
116457H	DEFLECTOR CRKSHFT OIL	1
118540H X	FLYWHEEL W/RING GEAR ASM	1
118542H	BOLT FLYWHEEL TO CRKSHFT	6
118639H	BOLT FLYWHEEL TO CRKSHFT	*
75141H	WIRE FLYWHEEL TO CRKSHFT BOLT USE WITH 118542H	3
34579HA	GASKET CRKSHFT REAR BRG OIL SEAL LOWER RETAINER	2
16122DA	GASKET CRKSHFT REAR BRG OIL SEAL UPPER RETAINER	1
61544H	GEAR RING FLYWHEEL	1
77460R91	GEAR SET CRKSHFT/CAMSHAFT	1
49453HA	GEAR CAMSHAFT	1
118532H	GEAR CRKSHFT	1
62531V	KEY PULLEY TO CRKSHFT	1
103909	KEY WOODRUFF 1/4X1 1/8 CRKSHFT GEAR	1
67581R92	RING SET, PISTON 020 O/S	1
83864R1	RING COMPR PISTON	6
61395H	RING COMPR PISTON	12
77377HA	RING OIL PISTON	6
118705HBX	BEARING CONN ROD ASM STD TWO 118705HB	6
131898HBX	BEARING CONN ROD ASM 002 U/S TWO 131898HB	6
135140HBX	BEARING CONN ROD ASM 010 U/S TWO 135140HB	6
125696HBX	BEARING CONN ROD ASM 020 U/S TWO 125696HB	6
118706HBX	BEARING CONN ROD ASM 030 U/S TWO 118706HB	6
137285HBX	BEARING CONN ROD ASM 040 U/S TWO 137285HB	6
118707HBX	BEARING CONN ROD ASM 060 U/S TWO 118707HB	6

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
71745R91	BEARING SET CONN ROD STD SIX 118705HBX	1
71746R91	BEARING SET CONN ROD 002 U/S SIX 131898HBX	1
71747R91	BEARING SET CONN ROD 010 U/S SIX 135140HBX	1
71748R91	BEARING SET CONN ROD 020 U/S SIX 125896HBX	1
71749R91	BEARING CONN ROD SET 030 U/S SIX 118706HBX	1
118704HA	BOLT CONNECTING ROD BRG CAP	12
71750R91	BEARING SET CONN ROD 040 U/S SIX 137285HBX	1
118701H X	ROD CONNECTING ASM	6
58446HDY	ARM VALVE ROCKER ASM	12
66700R1	BRACKET ROCKER ARM SHAFT PLAIN NO 1 AND 6	2
181129	BOLT HH 3/8NCX2 3/4	2
66364R1	STUD CYL HD/ROCKER ARM SHAFT BRKT TO CYL HEAD COVER	2
66700R1	BRACKET ROCKER ARM SHAFT PLAIN NO 2 AND 5	2
181129	BOLT HH 3/8NCX2 3/4	4
66701R1	BRACKET ROCKER ARM SHAFT CLAMPING NO 3 AND 4	2
181129	BOLT HH 3/8NCX2 3/4	2
66364R1	STUD CYL HD/ROCKER ARM SHAFT BRKT TO CYL HD COVER	2
117081HA	BRACKET ROCKER ARM SHAFT OIL	1
118637HB	BUSHING ROCKER ARM	12
80319R1	CLIP ROCKER ARM OIL CONTROL	12
16044D	COUPLING ROCKER ARM SHAFT	1
61481HA	COVER LIFT ROD	1
181082	BOLT HH 5/16 NCX1/2	6
37564HA	WASHER LIFT ROD COVER BOLT	6
59966R1	CUP VALVE SPRING EXH	6
93913H	CUP VALVE SPRING INTAKE	6
59967R1	CUP VALVE TIP	6
61482H	GASKET LIFT ROD COVER	1
80320H	GASKET ROCKER ARM SHAFT OIL BRKT	1
93910H	GUIDE VALVE STEM EXHAUST	6
93909H	GUIDE VALVE STEM INTAKE	6
38763H	NUT LOCK ROCKER ARM ADJ SCREW	12
172531	PLUG EXPANSION 3/4 ROCKER ARM SHAFT	2
59965R1	RETAINER VALVE SPRING EXHAUST	12

VENDOR: International Harvester Company	Red Diamond #406 ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	ENGINE AND CLUTCH	
93914H	RETAINER VALVE SPRING INTAKE	12
61480H	RETAINER VALVE TAPPET	12
16047D	RING SNAP ROCKER ARM	2
84416R91	ROD VALVE LIFTER ASM	12
84414R91	ROD VALVE LIFTER ASM	*
16067DA	SCREW ROCKER ARM ADJ	12
59964R1	SEAT EXH VALVE STD	6
61525R1	SEAT EXH VALVE 030 O/S	6
115815H	SEAT INTAKE VALVE STD	6
117861H	SEAT INTAKE VALVE 030 O/S	6
61471H8X	SHAFT ROCKER ARM ASM FRT	1
61472H8X	SHAFT ROCKER ARM ASM REAR	1
62266V	SPACER VALVE SPRING	12
16043D	SPRING ROCKER ARM SHAFT FRT/REAR	2
16045D	SPRING ROCKER ARM SHAFT INTER	4
62264VA	SPRING VALVE INNER	12
62265VA	SPRING VALVE OUTER	12
16040DD	TAPPET VALVE STD	12
87504R91	TAPPET VALVE STD	*
61104VD	TAPPET VALVE 005 O/S	12
87520R91	TAPPET VALVE 005 O/S	*
59968R1	VALVE EXHAUST	6
115817H	VALVE INTAKE	6
113934H	WASHER ROCKER ARM SHAFT BRKT KEY	2
11002VA	WASHER ROCKER ARM SHAFT OIL BRACKET BOLT	1
16051D	WASHER ROCKER ARM SPRING	2
70259R1	BEARING CAMSHAFT FRONT	1
77514R1	BEARING CAMSHAFT REAR	1
70260R1	BEARING CAMSHAFT SECOND	1
77513R1	BEARING CAMSHAFT THIRD	1
118544HA	CAMSHAFT	1
16027DA	FLANGE THRUST	1
220914	BOLT HH LOCK 3/8NCX7/8	2
62275VA	GASKET CAMSHAFT REAR BEARING COVER PLATE	1
77460R91	GEAR SET CAMSHAFT/CRKSHFT SEE GROUP 1206E1	1
127559	KEY WOODRUFF 1/4X3/4 CAMSHAFT GEAR	1
62274VA	PLATE REAR BEARING COVER	1
181059	BOLT HH 1/4NCX1/2	4

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
160260B	NUT CAMSHAFT GEAR	1
160250	RETAINER CAMSHAFT GEAR NUT	1
118630H X	COVER GEAR CASE ASM	1
179849	BOLT HH 3/8 NCX2 1/2	3
115093	WASHER LOCK 3/8 MED	3
	COVER TO CRANKCASE	
181129	BOLT HH 3/8NCX2 3/4	1
118775	WASHER FLAT 3/8	1
115093	WASHER LOCK 3/8	1
	GROUND STRAP/COVER TO CRKCSE	
182738	BOLT HH 3/8NFX2 1/2	2
121939	NUT HEX 3/8 NF	2
115093	WASHER LOCK 3/8 MED	2
	COVER TO PLATE	
161700	GASKET GEAR CASE COVER PLT	1
	TO CRANKCASE	
54648H	GASKET GEAR CASE COVER TO PLATE	1
83811H	INDICATOR TIMING	1
54647H	PLATE GEAR CASE COVER TO CRKCSE	1
181111	BOLT HH 3/8 NCX7/8	2
115093	WASHER LOCK 3/8 MED	2
	PLATE TO CRANKCASE	
136438H	BODY OIL FILLER ASM	1
181127	BOLT HH 3/8 16NCX2 1/4	2
115093	WASHER LOCK 3/8 MED	2
118685H X	BODY OIL PUMP W/IDLER SHAFT ASM	1
129119H	CAP OIL FILLER ASM	1
118690H	COVER OIL PUMP BODY	1
181063	BOLT HH 1/4 NCX3/4	6
115109	WASHER LOCK 1/4 MED	6
118693H	FLOAT OIL PUMP ASM	1
103386	PIN COTTER 1/8X1 1/4	1
160970	GASKET OIL FILLER BODY	1
3405H	GASKET OIL PAN DRAIN PLUG	1
160850A	GASKET OIL PAN FRONT	1
130521H	GASKET OIL PAN LEFT	1
161080B	GASKET OIL PAN REAR	1
130520H	GASKET OIL PAN RIGHT	1
160780B	GASKET OIL PUMP BODY COVER	AR
118692H	GASKET OIL PUMP TO CRANKCASE	1
84046R11	GAUGE OIL LEVEL ASM	1
161120B	GEAR DRIVE OIL PUMP SHAFT	1
	10 TEETH SPIRAL	
112011	PIN STGHT 1/8X7/8	1
118688H	GEAR IDLER OIL PUMP BODY	1
54658H	GUIDE OIL PUMP SHAFT TOP	1
103905	KEY WOODRUFF 1/8X5/8	1
	OIL PUMP SHAFT	

VENDOR: International Harvester Company

Red Diamond #406

ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	ENGINE AND CLUTCH	
16172DF	PAN OIL W/DRAIN PLUG ASM	1
181108	BOLT HH 3/8 NC X 3/4	10
181114	BOLT HH 3/8 NCX1 1/4	10
427195	NUT HEX 3/8NC	10
121939	NUT HEX 3/8 NF	2
16089D	STUD OIL PAN	2
115093	WASHER LOCK 3/8 MED	2
41300HA	PLUG DRAIN OIL PAN	1
118685H Z	PUMP OIL W/FLOAT ASM	1
181114	BOLT HH 3/8 NCX1 1/4	2
138544	WASHER LOCK 3/8 INT	2
16082D	SHAFT OIL PUMP IDLER GEAR	1
118686H X	SHAFT OIL PUMP W/DRIVEN GEAR ASM	1
118557H	TUBE OIL LEVEL GAUGE	1
34259H	WASHER OIL LEVEL GAUGE FELT	1
117768H	BASE OIL FILTER	1
74476R11	BASE OIL FILTER W/DRAIN PLUG ASM	1
70688H	CAP OIL FILTER COVER PERFORATED	1
70690H	CARTRIDGE OIL FILTER	1
64095R11	COVER OIL FILTER ASM	1
61982HC	FILTER OIL ASM	1
74465R91	FILTER OIL ASM	1
181165	BOLT HH 1/2NCX1 1/2	3
181165	BOLT HH 1/2NCX1 1/2	2
181176	BOLT HH 1/2NCX3 3/4	2
121972	NUT HEX 1/2NF	1
112616HA	STUD OIL FILTER	1
116121	WASHER LOCK 1/2 MED	4
70665H	FITTING OIL FILTER COVER TOP W/HANDLE ASM	1
117778H	GASKET OIL FILTER CENTER TUBE	1
70666H	GASKET OIL FILTER COVER TOP FITT	1
3405H	GASKET OIL FILTER PRESSURE RELIEF VALVE RETAINING PLUG	1
117779H	GASKET OIL FILTER SHELL TO BASE	1
26719HB A	GASKET OIL FILTER TO CRKCASE	10
72998RJ	GASKET OIL FILTER TO CRKCSE	1
64096R1	GASKET OIL FILTER TOP COVER	1
67093R1	NUT SPEED OIL FILTER COVER OIL FILTER COVER PERFORATED CAP	1
117773H	PLATE OIL FILTER SHELL RETAINING	1

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
74390H	PLUG OIL FILTER DRAIN	1
61263VA	PLUG OIL FILTER PRESSURE RELIEF VALVE RETAINING	1
72995R1	PLUG OIL FILTER PRESSURE RELIEF VALVE RETAINING	2
103865	PLUG PIPE SQ HD 1/8 OIL FILTER BASE	1
64094R91	SHELL OIL FILTER ASM	1
117774H	SPACER OIL FILTER CARTRIDGE	1
49946HA	SPRING OIL FILTER RELIEF VALVE	1
72997R1	SPRING OIL PRESSURE RELIEF VALVE	2
117775H X	TUBE OIL FILTER CENTER ASM	1
61261V	VALVE OIL FILTER PRESSURE RELIEF	1
72996R1	VALVE OIL FILTER PRESSURE RELIEF	2
137407	CONNECTOR INVERTED FLARED TUBE 3/8 NOT USED ON FIRST FEW TRUCKS WITH AIR BRAKES	
122865	COUPLING PIPE REDUCER 1/2 TO 1/4 USED ONLY FOR FIRST FEW TRUCKS	
86829R1	ELBOW STREET 90 DEGREE 1/2 TO 1/4 NOT USED ON FIRST FEW TRUCKS	1
141504	NIPPLE PIPE 1/2X1 1/2 USED ONLY FOR FIRST FEW TRUCKS	1
86862R91	PIPE VENTILATOR ASM 3/8X30 1/8 WITH 137399 NUTS	1
137600HA	VALVE METERING ASM	1
31497H	BOLT EXH MANF EXPANSION CLAMP	2
181113	BOLT HH 3/8NCX1 1/8 MANIFOLD TO ENGINE	4
16300R1	BOLT HH 7/16NFX4 3/4 INTAKE TO EXHAUST MANIFOLD	2
16312R1	BOLT HH 7/16NFX5 INTAKE TO EXHAUST MANIFOLD	2
54949HAX	CLAMP EXH MANF EXPANSION ASM	2
54948HA	GASKET EXH MANF EXPANSION CLAMP	AR
61499H	GASKET EXH TO INTAKE MANIFOLD	1
82928R1	GASKET INTAKE MANIFOLD TO CYL HD	1
82927R1	GASKET MANIFOLDS TO ENGINE	2
120546H	MANIFOLD EXH CENTER	1
54945HA	MANIFOLD EXH FRONT	1
54946HA	MANIFOLD EXH REAR	1
87549R11	MANIFOLD INTAKE ASM	1
54950H	NUT EXH MANF EXPANSION CLAMP	2
126260H	NUT INTAKE TO EXH MANIFOLD BOLT	8
93082H	NUT MANIFOLD TO ENGINE STUD	8
37684H	NUT MANIFOLD TO ENGINE STUD	*
82926R1	PILOT INTAKE MANIFOLD	2

PARTS LIST

VENDOR: International Harvester Company	Red Diamond #406 ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	ENGINE AND CLUTCH	
160160	GASKET FLYWHEEL HSG TO CRKCSE	1
61541H	HOUSING FLYWHEEL	1
50636H	BOLT FLYWHEEL HSG TO CRKCSE	6
123174	WASHER LOCK 1/2 HV	6
105906H	PIN DOWEL FLYWHEEL HSG TO CRKCSE	2
54951HA	STOP EXH MANF EXPANSION CLAMP BOLT	2
120583H	STUD MANIFOLD TO ENGINE	8
118775	WASHER FLAT 3/8 MANIFOLD TO ENGINE BOLT	4
127507H	WASHER MANIFOLD TO ENG STUD	6

VENDOR: International Harvester Company	Red Diamond #406 ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	COOLING SYSTEM	
	1100B1 FAN AND FAN BELT	
35974HA	BELT FAN	2
128829H	FAN ASM	1
89199R91	FAN ASM	*
181087	BOLT HH 5/16NCX7/8	4
116120	WASHER LOCK 5/16 MED	4
16074D	GASKET WATER OUTLET TO CYL HEAD	1
61493H	OUTLET WATER	1
181112	BOLT HH 3/8 NCX1	2
115093	WASHER LOCK 3/8 MED	2
50968HA	THERMOSTAT 145 TO 150 DEGREES	1
49862HA	THERMOSTAT 170 TO 175 DEGREES	1
98056H	BEARING WATER PUMP SHAFT FRT	1
41439H	BEARING WATER PUMP SHAFT REAR	1
87513R11	BODY WATER PUMP ASM	1
91406HA	CLAMP HOSE ADJ 3/4 TO 4	2
77490R1	CONNECTION ENGINE WATER INLET	1
16345R1	BOLT HH 3/8NCX3 3/8	2
115093	WASHER LOCK 3/8 MED	2
72990R1	ELBOW WATER PUMP BODY	1
181087	BOLT HH 5/16NCX7/8	2
116120	WASHER LOCK 5/16 MED	2
	ELBOW TO WATER PUMP	
16076D	GASKET INLET HOSE CONN TO CRKCSE	1
98449H	GASKET PUMP BODY COVER PLATE	1
16075D	GASKET WATER PUMP SUPPORT LUG	1
145102H	GASKET WATER PUMP BODY ELBOW	1
16073DA	GASKET WATER PUMP TO CYL HEAD	1
98048H	GUIDE WATER PUMP SEAL SPRING	1
16077D	HOSE WATER INLET CONN TO PUMP	1
98447H X	IMPELLER W/SEAL ASM	1
137543H	IMPELLER W/SEAL ASM	*
126041HB	KIT WATER PUMP REPAIR	1
98056H	BEARING WATER PUMP SHAFT FRT	1
41439H	BEARING WATER PUMP SHAFT REAR	1
98449H	GASKET PUMP BODY COVER PLATE	1
16075D	GASKET WATER PUMP SUPPORT LUG	1
16073DA	GASKET WATER PUMP TO CYL HEAD	1
98447H X	IMPELLER W/SEAL ASM	1
98054H	LOCK HALF RING WATER	2

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	PUMP SHAFT	
98046H	NUT FAN PULLEY	1
98058H	RING SNAP WATER PUMP SHAFT BRG	1
128691H	SHAFT WATER PUMP	1
98055H	SLINGER WATER PUMP SHAFT	1
98448H	SPACER WATER PUMP SHAFT BRG	1
18927H	WASHER FAN PULLEY NUT	1
98054H	LOCK HALF RING WATER PUMP SHAFT	2
98450H	PLATE WATER PUMP BODY COVER	1
181059	BOLT HH 1/4NCX1/2	5
103885	PLUG PIPE SLT HD 3/8	1
	WATER PUMP BODY	
134428H	PULLEY FAN	1
98046H	NUT FAN PULLEY	1
18927H	WASHER FAN PULLEY NUT	1
87512R91	PUMP WATER ASM	1
181114	BOLT HH 3/8 NCX1 1/4	2
115093	WASHER LOCK 3/8 MED	2
98052H	RING SNAP WATER PUMP SEAL	1
98058H	RING SNAP WATER PUMP SHAFT BRG	1
98050H	RING WATER PUMP SEAL CLAMP FOR 98447H X	1
98049H	SEAL WATER PUMP FOR 98447H X	1
137517HA	SEAL WATER PUMP FOR 137543H	1
128691H	SHAFT WATER PUMP	1
98055H	SLINGER WATER PUMP SHAFT	1
98448H	SPACER WATER PUMP SHAFT BRG	1
98047H	SPRING FOR 98447H X	1
98051H	WASHER CARBON WATER PUMP SEAL	1

VENDOR: International Harvester Company

Red Diamond #406

ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	FUEL SYSTEMS	
90543R1	BAR NOZZLE LEFT	1
90542R1	BAR NOZZLE RIGHT	1
52828R91	BEARING THROTTLE SHAFT GOV END	1
90916R91	BODY AIR INTAKE ASM	1
55048R1	SCREW AIR INTAKE BODY TO MAIN	6
	BODY W/LOCK WASHER ASM	
90548R91	BODY MAIN W/PLUGS ASM	1
82845R91	SCREW W/LOCK WASHER ASM	2
63953R1	SCREW THROTTLE BODY LONG	1
131200	WASHER LOCK 1/4 LGT	1
90536R11	BODY THROTTLE W/SHAFT ASM	1
90559R11	BRACKET CHOKE WIRE ASM	1
120687	SCREW FIL HD NO 10NCX1/2	2
131119	WASHER LOCK NO 10 HV	2
52758R1	BRACKET FLOAT LEVER	1
145368	SCREW RD HD NO 2X1/4	2
26112H0	BRACKET GOV AIR LINE SUPT FRONT	1
51481R11	BRACKET GOV AIR LINE SUPT SIDE	1
420859	SCREW FIL HD SLT 1/4NFX3/4	3
52895R1	BRACKET THROTTLE LEVER	1
	RETURN SPRING	
84033R92	CARBURETOR ASM	1
121923	NUT HEX 5/16 NF	3
57049H	STUD CARBURETOR MTG	3
116120	WASHER LOCK 5/16 MED	3
58737R1	CLAMP CHOKE BRACKET	1
134536	NUT SQ NO 8NC	1
131970	SCREW FIL HD NO 8NCX1/2	1
90539R1	CLAMP NOZZLE BAR	2
140776	CLIP GOVERNOR AIR LINE	2
52912R1	CONNECTOR ADJ GOV VALVE	1
	WEIGHT SPRING	
52865R11	COVER GOV DIAPH HSG ASM	1
82882R91	SCREW W/LOCK WASHER ASM	5
82885R91	SCREW GOV DIAPH HSG COVER	3
26122H0	CUP GOV TO DIAPH BODY LINE NUT	AR
	SEAL	
52860R91	DIAPHRAGM GOV W/ROD ASM	1
118753	ELBOW 1/4 GOV AIR LINE AT VALVE	2
90557R91	FLOAT W/LEVER ASM	1
90527R1	GASKET AIR INTAKE BODY TO	1

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	MAIN BODY	
82924R1	GASKET CARBURETOR MOUNTING	2
52874R1	GASKET GOV DIAPH HSG COVER PLT	1
52850R1	GASKET GOV DIAPH HSG TO THROTTLE BODY	1
52909R1	GASKET GOV VALVE WEIGHT SEAT	1
52807R1	GASKET NOZZLE BAR NEOPRENE	4
90526R1	GASKET THROTTLE BODY TO MAIN BODY	1
52844R1	GASKET THROTTLE LEVER TO THROTTLE BODY	1
54784R91	HOUSING GOVERNOR W/VALVE ASM	1
59861R1	BOLT GOVERNOR HOUSING MTG	1
181071	BOLT HH 1/4NCX1 3/4	1
115109	WASHER LOCK 1/4 MED	2
83094R11	HOUSING GOV DIAPH W/PLUG ASM	1
82884R91	SCREW W/LOCKWASHER ASM	3
52897R11	HOUSING GOV VALVE W/BUSHING ASM	1
87379R11	HOUSING THROTTLE OPER SHAFT W/BUSHING ASM	1
87378R91	SCREW W/LOCK WASHER ASM	2
82925R1	INSULATOR CARBURETOR MOUNTING	1
87390R1	JET GOVERNOR BY-PASS 047	1
87391R1	JET GOVERNOR BY-PASS 025	1
54745R1	JET MAIN NO 63	2
90558R11	LEVER CHOKE W/SWIVEL ASM	1
52868R11	LEVER GOV DIAPH TO THROTTLE SHAFT	1
52871R1	NUT GOV DIAPH TO THROTTLE SHAFT LEVER	1
116118	WASHER LOCK NO 8 MED	1
74083R11	LEVER THROTTLE W/BALL ASM	1
90525R91	LINK ACCEL PUMP ASM	1
58776R1	NEEDLE IDLE ADJUSTING	2
89578R11	NOZZLE ACCEL PUMP DISCHARGE ASM	1
118537	NUT FLARED TUBE 1/4 CARB GOV VACUUM/AIR LINES	AR
140381	NUT FLARED TUBE 5/16 FUEL PIPE	AR
137398	NUT FLARED TUBE 5/16 FUEL PIPE	AR
120619	NUT SQ NO 10NC THROTTLE LEVER CLAMP SCREW	1
52870R1	PIN COTTER 3/64X3/8 ACCEL PUMP LINK	1
52870R1	PIN COTTER 3/64X3/8 GOV DIAPH	1
52854R1	PIN GOV ANCHOR SPRING	1

PARTS LIST

VENDOR: International Harvester Company	Red Diamond #406 ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	FUEL SYSTEMS	
52914R1	PIN GOV VALVE WEIGHT SPRING	2
142959	PIN GROOVE 7/64X3/4	1
	THROTTLE LEVER RETAINING	
86683R91	PIPE AIR ASM	1
	1/4X54 3/16 WITH 118537 NUTS	
	CARB AIR INTAKE BODY TO GOV	
84437R91	PIPE FUEL ASM	1
	5/16X42 9/16 WITH 140381 NUTS	
	FUEL PUMP TO CARBURETOR	
	USE W/84436R91 FUEL PUMP	
87544R91	PIPE FUEL ASM	1
	5/16X 37 5/8 WITH 137398	
	AND 140381 NUTS	
	FUEL PUMP TO CARBURETOR	
	USE W/83390HB FUEL PUMP	
91512H	CLIP FUEL PIPE	1
426395	NUT HEX 1/4NC	1
124060	SCREW RD HD 1/4 NC X 1/2	1
115109	WASHER LOCK 1/4 MED	1
44197H	LOOM PIPE CLIP 5/16X3/4 SPLIT	1
86684R91	PIPE VACUUM ASM	1
	1/4X46 5/16 WITH 118537 NUTS	
	AND 26122H0 CUPS	
	CARBURETOR GOV TO DIAPH BODY	
63959R91	PISTON ACCEL PUMP ASM	1
90914R91	PISTON ECONOMIZER W/STEM ASM	1
90411R91	PLATE CHOKE ASM	1
52774R1	SCREW CHOKE PLATE	2
75707R1	PLATE GOV DIAPH HSG COVER	1
82883R91	SCREW W/LOCK WASHER ASM	4
90567R1	PLATE NAME	1
125622	SCREW RD HD NO 0X3/16	2
90535R1	PLATE THROTTLE SHAFT	2
52774R1	SCREW THROTTLE SHAFT PLATE	4
52832R1	PLUG AIR HORN PASSAGE	1
52759R1	PLUG CHOKE SHAFT	1
52899R1	PLUG GOV VALVE ADJ HOLE	1
52810R1	PLUG MAIN JET PASSAGE	2
52802R1	PLUG NOZZLE BAR AIR BLEED	2
125947	PLUG PIPE 1/8	1

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	GOV HOUSING OIL WICK RESERVOIR	
89579R1	PLUG PUMP DISCHARGE OUTLET	2
89530R91	BODY AIR CLEANER ASM	1
77442R1	BRACKET AIR CLEANER SUPT	1
181086	BOLT HH 5/16XNCX3/4	4
116120	WASHER LOCK 5/16 MED	4
120580H X	CLAMP AIR CLEANER AIR SEAL ASM	2
124055	SCREW RD HD 1/4NCX1	2
91406HA	CLAMP HOSE ADJ 3/4 TO 4 CAP	2
	AIR CLEANER TO ELBOW HOSE	
91406HA	CLAMP HOSE ADJ 3/4 TO 4 CAP	2
	BREATHER HOSE AT NIPPLE	
130879HB	CLAMP OIL CUP RET W/BOLT ASM	1
88170R91	CLEANER AIR ASM	1
182697	BOLT HH 5/16XNFX1 3/4	2
121923	NUT HEX 5/16 NF	2
87397R91	CUP OIL ASM	1
88169R91	ELBOW AIR CLEANER TO CARBURETOR	1
84052R1	HOSE BREATHER 1/2X13 3/4	1
88759H	HOSE CLEANER TO ELBOW	1
	2 15/16X3 1/16	
68406H	NIPPLE HOSE IN ENG VALVE COVER	1
120581H	SEAL CARBURETOR AIR	1
77443R1	TUBE AIR CLEANER SUPT	1
77440R1	PIN CLAMP	1
121939	NUT HEX 3/8 NF	1
118775	WASHER FLAT 3/8	1
115093	WASHER LOCK 3/8 MED	1
88163R1	BELLOWS AIR CLEANER TO AIR DUCT	1
88880R11	BOX HOOD AIR INLET ASM	1
163210	SCREW PH HD TAP NO 10X3/8	4
88048R1	BRACKET AIR DUST SUPPORT	1
182650	BOLT HH 1/4NFX5/8	3
121908	NUT HEX 1/4 NF	3
118664	WASHER FLAT 1/4	5
115109	WASHER LOCK 1/4 MED	3
	BRKT TO LT SPLASH PANEL	
89400R1	BRACKET AIR CONTROL ROD	1
	COWL/PLR TO INST PNL MTG BOLTS	
248870R1	BUSHING AIR CON ROD AT CON BRKT	1
131228H	BUSHING AIR CONTROL ROD AT DASH	1
88158R91	CLAMP ADJ AIR CLEANER TO	2
	AIR DUCT BELLOWS	
88210R91	DUCT AIR INTAKE CONTROL ASM	1
426395	NUT HEX 1/4 NC	4
118664	WASHER FLAT 1/4	4

PARTS LIST

VENDOR: International Harvester Company

Red Diamond #406

ENGINE

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
	FUEL SYSTEMS	
115109	WASHER LOCK 1/4 MED	4
77800R91	KNOB AIR CONTROL ROD	1
89192R1	ROD AIR CONTROL	1
137137	PIN COTTER 1/16X1/2	1
12190R1	WASHER FLAT 3/16	1
88155R1	SEAL AIR DUCT CONTROL VALVE	1
88154R1	SEAL AIR DUCT TO HOOD	1
131804H	SPRING AIR DUCT CONTROL VALVE	1
46935D	ARM ROCKER	1
51348VA	BAIL FUEL BOWL ASM	1
24153D	BODY FUEL PUMP	1
51344V	BOWL FUEL	1
69785H	BREATHER ASM	1
23543D	COVER FUEL PUMP W/VALVE SEATS ASM	1
130894H	SCREW FUEL PUMP COVER	10
122158	WASHER LOCK NO 10	10
51615D X	DIAPHRAGM W/GASKET ASM	1
118754	ELBOW FLARED TUBE 5/16 PUMP INLET PIPE	1
137422	ELBOW FLARED TUBE 5/16 PUMP OUTLET PIPE	1
51346VA	GASKET FUEL BOWL	1
16786D	GASKET FUEL PUMP TO CRANKCASE	1
23535D	GASKET INLET AND OUTLET VALVE	2
23560D	GASKET OIL SEAL	1
75233R91	KIT REPAIR FUEL PUMP	1
115467H	DIAPHRAGM ASM	1
62572D	GASKET DIAPHRAGM	1
51346VA	GASKET FUEL BOWL	1
16786D	GASKET FUEL PUMP TO CRANKCASE	1
23535D	GASKET INLET AND OUTLET VALVE	2
23560D	GASKET OIL SEAL	1
23563D	LINK ROCKER ARM	1
27688H	NUT DIAPHRAGM PULL ROD	1
23568D	PIN ROCKER ARM	1
23564D	RING RETAINING ROCKER ARM PIN	2
23516D	SCREEN FUEL FILTER	1
130894H	SCREW FUEL PUMP COVER	2
142743H	SPRING DIAPHRAGM	1

IH PART NUMBER	DESCRIPTION	NUMBER REQUIRED
26095D	SPRING INLET AND OUTLET VALVE	2
23547D	SPRING ROCKER ARM	1
23533D	VALVE INLET AND OUTLET	2
23550D	WASHER DIAPHRAGM PULL ROD	1
122158	WASHER LOCK NO 10 FUEL PUMP COVER SCREW	2
23561D	WASHER SPACER ROCKER ARM LINK	2
	1500C1 FUEL PUMP AC STANDARD CONTINUED	
23563D	LINK ROCKER ARM	1
23544D	NUT FUEL BOWL BAIL THUMB	1
86594R11	PAN FUEL PUMP DRIP ASM	1
23568D	PIN ROCKER ARM	1
23534D	PLUG INLET VALVE	1
23551D	PLUG OUTLET VALVE W/AIR DOME ASM	1
39796D	PROTECTOR DIAPHRAGM LOWER	1
23532D	PROTECTOR DIAPHRAGM UPPER	1
83390HB	PUMP FUEL ASM	1
181112	BOLT HH 3/8 NCX1	2
115093	WASHER LOCK 3/8 MED	2
25483D	RETAINER OIL SEAL GASKET	1
23564D	RING RETAINING ROCKER ARM PIN	2
23566D	ROD PULL DIAPHRAGM	1
33420D	SCREEN FUEL FILTER	1
23515D	SEAT FUEL BOWL	1
46938D	SPRING DIAPHRAGM	1
26095D	SPRING INLET AND OUTLET VALVE	2
23547D	SPRING ROCKER ARM	1
23533D	VALVE INLET AND OUTLET	2
23522D	WASHER DIAPHRAGM ALIGNMENT	1
23550D	WASHER DIAPHRAGM PULL ROD	1
118775	WASHER FLAT 3/8 FUEL PUMP DRIP PAN MTG	2
23561D	WASHER SPACER ROCKER ARM LINK	2

VENDOR: Holley Carburetor Company	Holley Carburetor 852-FFG

Part Number	Description	No. Req'd
1R-462A	AIR HORN & PLUGS ASSEMBLY	
	Air Horn.......(*Not Procurable*: *See Basic Subassembly*)	1
2R-64A	Plate Assembly — Choke	
2R-155A		1
3R-93	Shaft — Choke	1
4R-160A	Lever Assembly — Choke	1
4R-236	Lever — Choke	
5R-4	Screw — No. 6-32 NC 2 x .28 in.	6
5R-12	Screw — No. 12-24 NC 2 x .56 in.	1
5R-16	Screw — No. 8-32 NC 2 x .44 in.	1
5R-42	Screw — Drive, 5/64 x 1/4 in.	2
5R-127	Screw — No. 10-24 NC 2 x .50 in.	2
5R-159	Screw — Drive, No. 0 x .19 in.	2
5R-223	Screw — Hexagon Head, No. 10-24 NC 2 x 5/8 in.	1
***5R-230**	Screw — 1/4-28 NF 2 x 1-3/4 in..	1
5R-259	Screw — No. 8-32 NC 2 x .50 in.	1
5R-290	Screw & Lock Washer Assembly No. 10-32 NF 2 x .62 in.	6
5R-292	Screw & Lock Washer Assembly No. 8-32 NC 2 x .88 in.	4
5R-332	Screw & Lock Washer Assembly 1/4-28 NF 2 x .81 in.	4
5R-366	Screw — No. 10-32 NF 2 x .38 in.	4
5R-367	Screw & Lock Washer Assembly No. 10-32 NF 2 x .56 in.	3
5R-368	Screw & Lock Washer Assembly No. 10-32 NF 2 x 1.00 in.	2
5R-370	Screw & Lock Washer Assembly No. 8-32 NC 2 x .62 in.	5
5R-371	Screw & Lock Washer Assembly No. 8-32 NC 2 x .62 in.	3
5R-372	Screw & Lock Washer Assembly No. 10-32 NF 2 x 1.12 in.	1
6R-677A	MAIN BODY & PLUGS ASSEMBLY	
	Body — Main ....(*Not Procurable*: *See Basic Subassembly*)	1
7R-17	Plug	1
7R-39	Plug — Main Jet Passage	2
7R-122	Plug — Passage	8
8R-5	Gasket — Nozzle Bar Air Bleed	2
8R-6	Gasket — Fuel Inlet Valve Seat	1
8R-7	Gasket — Neoprene	4
8R-49	Gasket — Power Jet Valve	1
8R-94	Gasket — Body	1
8R-96	Gasket — Main Jet Passage Plug	2
8R-120	Gasket — Pump Discharge Jet	1
8R-217	Gasket — Throttle Bearing Cover	1
8R-219	Gasket — Governor Cover	1
8R-235	Gasket — Governor to Throttle Body	1
8R-529	Gasket — Flange	1
8R-515	Gasket — Throttle Barrel	1
9R-46	Plate — Throttle	2

PARTS LIST

Part Number	Description	No. Req'd
10R-285A	Shaft & Bearing Assembly — Throttle	1
10R-287A	Shaft Assembly — Throttle Operating	1
10R-322A		
11R-328A	Lever & Ball Assembly — Throttle	1
12R-696A	**THROTTLE BODY & SHAFT ASSEMBLY**	
	Body — Throttle ....(*Not Procurable: See Basic Subassembly*)	1
13R-68	Bearing — Throttle Shaft	1
14R-5A	Tube Assembly — Idle (No. 64)	2
15R-52	Needle — Idle Adjusting	2
16R-33	Bracket — Float Lever	1
16R-42A	Float & Lever Assembly	1
17R-1	Shaft — Float	1
18R-2A	Valve & Seat Assembly — Fuel Inlet	1
19R-59	Connector — Vacuum	2
19R-64	Fitting — Fuel Inlet	1
21R-5-2	Plug — Nozzle Bar Air Bleed	2
21R-241	Bar — Nozzle, L. H.	1
21R-270A	Bar & Collar Assembly — Nozzle, L. H.	
21R-243	Bar — Nozzle, R. H.	1
21R-272A	Bar & Collar Assembly — Nozzle, R. H.	
21R-245A	Nozzle Assembly — Pump Discharge (No. 66)	1
22R-40	Jet — Main (No. 53)	
22R-40	(No. 61)	
22R-40	(No. 63)	2
22R-53-47	Jet — Governor By-Pass	1
22R-57-25	Jet — Governor By-Pass	1
25R-72A	Valve Assembly — Power Jet (No. 39)	
25R-72A	(No. 49)	1
25R-72A	(No. 66)	
*25R-123A	Piston & Stem Assembly — Economizer	1
25R-147A		
27R-1	Packing — Felt	2
27R-31	Seal — Governor & Throttle Shaft	1
27R-51	Seal — Lead	2
27R-52	Wire — Seal, 2 strands, soft tinned, .025 in. dia. wire	2
28R-1	Valve — Pump Discharge	1
28R-94	Valve — Pump Check	1
29R-96	Pin — Spring (long)	1
29R-254	Pin — Retaining	1
30R-64A	Piston Assembly — Accelerating Pump	1
31R-64A	Rod Assembly — Pump Operating	1
33R-115A	Link Assembly — Pump	1
34R-422A	Cover Assembly — Diaphragm	1
34R-565	Cover — Governor	1
34R-585A	Housing Assembly — Throttle Operating Shaft	1
35R-15A	Diaphragm & Rod Assembly	1
37R-82	Stud — Pump Operating Rod	1
38R-51	Spring — Float	1
38R-87	Retainer — Pump Check Valve	1
38R-108	Spring — Idle Adjusting Needle	2
38R-110	Spring — Throttle Stop Screw	1
38R-174	Spring — Governor	1
38R-212	Spring — Throttle Shaft Retainer	1
38R-251	Spring — Pump Discharge Valve Retainer	1
38R-271	Spring — Throttle Shaft Bearing Retainer	1
38R-326	Spring — Throttle Return	1

VENDOR: Holley Carburetor Company	Holley Carburetor 852-FFG

Part Number	Description	No. Req'd
38R-351	Spring — Accelerating Pump	1
39R-1	Nut — Square, No. 8-32 NC 2	1
39R-5	Nut — Hexagon, No. 8-36 NF 2	1
39R-171	Nut — Square, No. 10-24 NC 2	1
46R-1	Washer — Accelerating Pump Spring	1
46R-2	Washer — Lock, Heavy, No. 10	2
46R-3	Washer — Lock, Light, 1/4 in.	1
46R-11	Retainer — Pump Operating Felt	1
46R-89	Retainer — Throttle Shaft Seal	1
46R-285	Washer — Lock, No. 8	1
48R-20	Retainer — Float Spring	2
48R-183	Pin — Cotter	2
49R-42	Clamp — Nozzle Bar	2
49R-109	Bracket — Throttle Lever Spring	1
49R-119A	Bracket Assembly — Choke	1
49R-178	Retainer — Choke Shaft Felt	
63R-105A	Lever Assembly — Governor	1
78R-2	Tag — Identification	1
78R-4	Plate — Identification	1
79R-89A	Housing & Plugs Assembly — Governor	1

VENDOR: Chicago Manufacturing Co.	201-109 CAB ASSEMBLY

PART NO.	DESCRIPTION	NO. REQ.
202-10	Door Assembly	1
203-96	Glass, Windshield	1
203-37	Glass, R.H. Side Window	1
203-14	Glass, Rear Window	1
203-81	Glass, Front Side Window - R.H.	1
44-203-24	Glass, Front Side Window - L.H.	1
206-28	Glass, Mounting Rubber, Windshield - W/insert	1
206-10	Glass, Mounting Rubber, R.H. Side & Front W/insert.	1
212-10	Striker Plate	1
205-12	Handle, Rear Window Lift	2
204-11	Regulator, Rear Window Lift	1
202-11	Vent Door Complete	3
517-10A	Access Plate - R.H. Side	1
V-7AP-16	Cowling Fasteners	10
507-10A	Inner Rear Panel	1
202P-24	Vent Door Springs	3
01-92	Front Inspection Plate	1

VENDOR: Delco - Remy	1996048 Starter Switch

PART NO.	DESCRIPTION	NO. REQ.
1917869	Nut-Mounting	1
1864099	Screw-Terminal	2
1855978	Clip-Terminal	2

PARTS LIST

VENDOR: Delco-Remy		1116465 IGNITION SWITCH

PART NO.	DESCRIPTION	NO. REQ.
1855978	Clip - Terminal	3
1864099	Screw - Terminal	3
1849889	Lock and Key Assembly	1
1906758	Mounting Nut	1

VENDOR: Delco-Remy

1479

MAGNETIC SWITCH
CORROSION PROOF

Part No.	Description	No. Req'd
1913954	Nut - Terminal stud (3/8-16)	2
1904493	Lockwasher - Terminal stud nut (3/8)	2
1914535	Washer - Plain - Terminal stud nut	2
1914534	Nut - Terminal stud (8-32)	1
1915334	Lockwasher - Terminal stud (#8)	1

VENDOR: Delco-Remy	1115045 IGNITION COIL

Part No.	Description	No. Req'd
1903473	Nut - Terminal	2
1914615	Clip - Terminal	2

VENDOR: Delco-Remy	1112357 DISTRIBUTOR

Part No.	Description	No. Req'd
1913720	HOUSING	1
125947	Pipe plug - Housing	1
1909003	Bushing	1
824735	CAP - DISTRIBUTOR	1
821604	Carbon button - Dist. cap	1
1871838	Spring - Cap	2
1847289	Support - Cap spring	2
121832	Screw - Cap spring support	2
106496	Lockwasher - Cap spring support screw	2
820445	ROTOR	1
1913718	MAIN SHAFT & WEIGHT PLATE	1
1913719	CAM - ADVANCE & BREAKER	1
816803	Wick - Felt (In cam)	1
1847643	Plate - Breaker	1
121749	Screw - Breaker plate support	1
106496	Lockwasher - Breaker plate support screw	1
813238	LEVER - BREAKER	1
1848038	CONTACT POINT & SUPPORT	1
816784	Screw - Contact adjusting	1
1900272	CONDENSER	1
131949	Screw - Condenser attaching	1
106496	Lockwasher - Condenser attaching screw	1
1881371	Weight	4
1885339	Spring - Weight	2
1885557	Plate - Weight hold down	1
120614	Nut - Weight hold down plate attaching	2
1885558	Lockwasher - Weight hold down plate attach. nut	2
811912	Washer - Space - Under weight plate	1
1847647	Stud - Terminal	1
817363	Nut - Terminal Stud (Inside)	1
810794	Washer - Plain - Terminal stud (Inside)	1
1878405	Bushing - Ins. Term. stud (Inside)	1
1882247	Washer - Ins. Term. stud (Outside)	1
24754	Washer - Plain - Terminal stud (Outside)	1
121841	Lockwasher - Terminal stud (Outside)	1
120622	Nut - Terminal stud (Outside)	1
1864165	Collar	1
1857492	Pin - Collar attaching	1
811912	Washer - Space under collar	1
810074	Washer - Shim (.005 thk.) . . . . as needed	
810078	Washer - Shim (.010 thk.) . . . . as needed	

VENDOR: Delco-Remy	1118376 REGULATOR (C & V) CORROSION PROOF	
Part No.	**Description**	**No. Req'd**
1914807	Cover	1
1878510	Gasket - Cover	1
1914199	Screw - Cover	2
1914119	Washer - Ins. cover screw	2
1915812	Armature - Relay	1
1914817	Screw - Relay armature attaching	2
1914816	Lockwasher - Relay arm. attaching screw	2
1912159	Screw - Adjusting - Relay armature	1
1914831	Spring - Regulator armature	2
1912365	Screw - Regulator armature adjusting	2
1915038	Contact & Support - Regulator	2
1914808	Screw - Regulator contact attaching	4
1914803	Lockwasher - Regulator contact attach. screw	2
1914804	Bushing - Ins. Regulator contact attach. screw	4
1914805	Washer - Ins. Regulator contact attach. screw	5
1914802	Connector - Regulator contact attach. screw	1
1910177	Resistor "F" Term. to ground	1
1910174	Resistor "F" Term. to relay	1
1914766	Grommet (Rubber) In base	3
1914800	Screw - Terminal	3
1914801	Clamp - Terminal	3

VENDOR: Delco-Remy	1106835 GENERATOR

Part No.	Description	No. Req'd
1915857	ARMATURE	1
1915846	Pole shoe	2
1914750	Screw - Pole shoe	4
1909995	Bushing - Ins. terminal stud	2
1914751	Washer - Ins. terminal stud	2
1915799	Washer - Plain - Terminal stud	2
1915805	Lockwasher - Terminal stud	4
1913036	Nut - Terminal stud	4
1915842	Field Coil - R.H.	1
1915841	Terminal only	1
1915839	Field Coil - L.H.	1
1915841	Terminal only	1
809062	Dowel Pin - C.E. & D.E.	2
1915849	Cover band	1
1915879	FRAME - COMMUTATOR END	1
29047	Wick - C.E.	1
113702	Oiler - C.E.	1
954685	Ball bearing - C.E.	1
1888761	Washer - Space - Ball bearing - C.E.	1
1915847	Plate - Ball bearing retainer - C.E.	1
1914753	Gasket - Ball bearing retainer plate - C.E.	1
1914580	Screw - Ball bearing retainer plate - C.E.	3
1914576	Lockwasher - Ball bearing retainer plate - C.E.	3
1906926	Brush	2
1914193	Screw - Brush lead attaching	2
120217	Lockwasher - Brush lead attaching screw	2
1915845	Spring - Brush	2
1915837	Holder assem. - Brush - ground brush	1
1915831	Holder assem. - Brush - Ins. brush	1
1915844	Screw - Brush holder assem. - attach.	4
1914124	Nut - Brush holder assem. attaching screw	4
1915880	FRAME - DRIVE END	1
113702	Oiler - D.E.	1
29047	Wick - D.E.	1
908605	Ball bearing - D.E.	1
1915852	Collar - Space (Outside - D.E.)	1
1915855	Plate - Ball bearing retainer (Outside - D.E.)	1
1915850	Plate - Ball bearing retainer (Inside - D.E.)	1
1915851	Gasket - Ball bearing retainer plate (Inside - D.E.)	1
1915856	Screw - Ball bearing retainer plate attach. D.E.	6
1914576	Lockwasher - Ball bearing retainer plate attaching screw	6
124548	Woodruff Key - D.E.	1

Part No.	Description	No. Req'd
125384	Nut - Shaft - D. E.	1
1905046	Washer - Shaft nut - D. E.	1
1915383	Thru bolt	2
1914577	Lockwasher - Thru bolt	2
1915175	Screw (Top of field frame)	1
1915174	Lockwasher (Top of field frame)	1

PARTS LIST

VENDOR: Delco-Remy	1109006 CRANKING MOTOR

Part No.	Description	No. Req'd
1918337	ARMATURE	1
1905946	Pole shoe	6
1913960	Pole shoe screw	12
826938	Stud - Terminal	1
1913959	Washer - Ins. terminal stud (3/4 O.D.)	2
1913958	Washer - Ins. terminal stud (9/16 O.D.)	3
1913957	Washer - Plain - Terminal stud	1
1904493	Washer - Lock - Terminal stud	2
1913954	Nut - Terminal stud (1/4 thk.)	1
1904419	Nut - Terminal stud (5/16 thk.)	1
38278	Field Coil Assem. (R.H.)	1
38279	Field Coil Assem. (L.H.)	1
1913953	Insulating strip - Field Coil (Under stud)	1
1913963	Insulating strip (Triangular) (Under lead)	2
1913970	Cover band	1
1913113	Screw - Cover band	1
1918328	COMMUTATOR END FRAME	1
38296	Bushing - C.E.	1
1914854	End plug - C.E.	1
38367	Brush	6
1905146	Spring - Brush	6
1914847	Screw - Brush lead attaching	6
121841	Lockwasher - Brush lead attaching	6
1913945	Screw - C.E. Frame attaching	6
1914576	Washer - Lock - C.E. Frame attaching screw	6
1914842	Washer - Space - C.E.	1
1918343	GEAR HOUSING	1
802691	Wick - Gear housing	2
1913035	Plug - Oil hole	1
117201	Oiler - Gear housing	2
1918330	End plug gear housing	1
1918329	Screw - Gear housing attaching (Slotted hd.)	2
1913945	Screw - Gear housing attaching (Hex. hd.)	4
1914576	Washer - Lock - Gear housing attaching	6
1918332	Gear - Reduction	1
1913948	Woodruff Key - Reduction gear	1
1918331	Washer - Space (Between armature & gear housing)	1
1915148	Washer - Oil thrower (Between gear & cover plate)	1
1915149	Washer - Felt (Between oil thrower & cover plate)	1
1918335	Plate - D.E. housing cover	1
1918336	Washer - Space (Between oil thrower & motor drive)	1
1918344	DRIVE END HOUSING	1
826462	Bushing-D.E.	1
117201	Oiler-D.E.	1
802691	Wick-D.E.	1
1918330	Screw - D.E. housing attaching	4

Part No.	Description	No. Req'd
1914655	Lockwasher - D.E. housing attaching screw	4
1914842	Washer - Space - D.E.	1
1918341	MOTOR DRIVE (For parts see Motor Drive Advance writeup)	1
1913948	Woodruff Key - Motor Drive attaching	2
1918342	Shaft - Motor drive	1
1480	SWITCH (For parts see Magnetic switch Advance writeup)	1
1915098	Screw - Switch attaching	2
1915174	Lockwasher - Switch attaching screw	2
1915097	Connector - Switch terminal & motor term.	1

VENDOR: Delco-Remy

1918341

MOTOR DRIVE
(Eclipse #A-2713)

Part No.	Description	No. Req'd
1918543	GEAR & SHAFT ASSEM.	1
1902737	Service sleeve	1
1902730	Drive head	1
1902731	Drive spring	1
1902733	Screw - Head spring	1
1902732	Screw - Shaft spring	1
1902736	Lockwasher - Spring screw	2
1902734	Back stop	1
1902735	Screw - Back stop	1

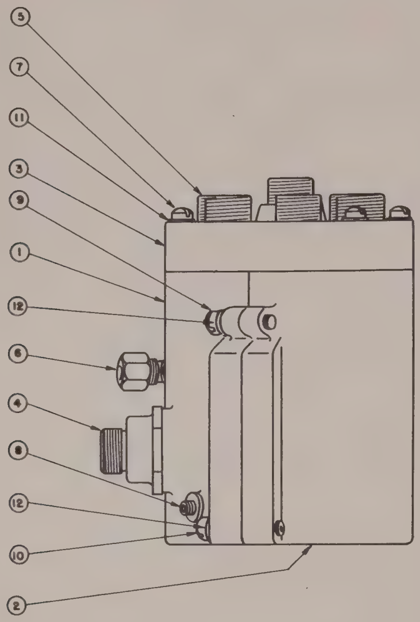
VENDOR: HALLETT MANUFACTURING COMPANY	4034 Shielding Kit--1 HC 406 Red Diamond Specification MIL. -S-10379

KIT - 4034A

QUANTITY	PART NUMBER	DESCRIPTION
1	4035	Distributor Shield
1	2285	Coil Cap Shield
4	4465	Capacitor & Lead (1 Coil, 1 Generator, 2 Regulators)
1	4432	L. T. Coil Lead
1	1016	H. T. Coil Lead
1	1010	#1 Plug Lead
1	1011	#2 Plug Lead
1	1012	#3 Plug Lead
1	1013	#4 Plug Lead
1	1014	#5 Plug Lead
1	1015	#6 Plug Lead
1	1293	Armature Lead
1	1294	Field Lead
1	----	Fungus Treatment
1	2511	Pilot Tube
1	4254	Coiled Vent Tube
2	4536	Bond Strap (Coil Shields & Distributor)

PARTS LIST

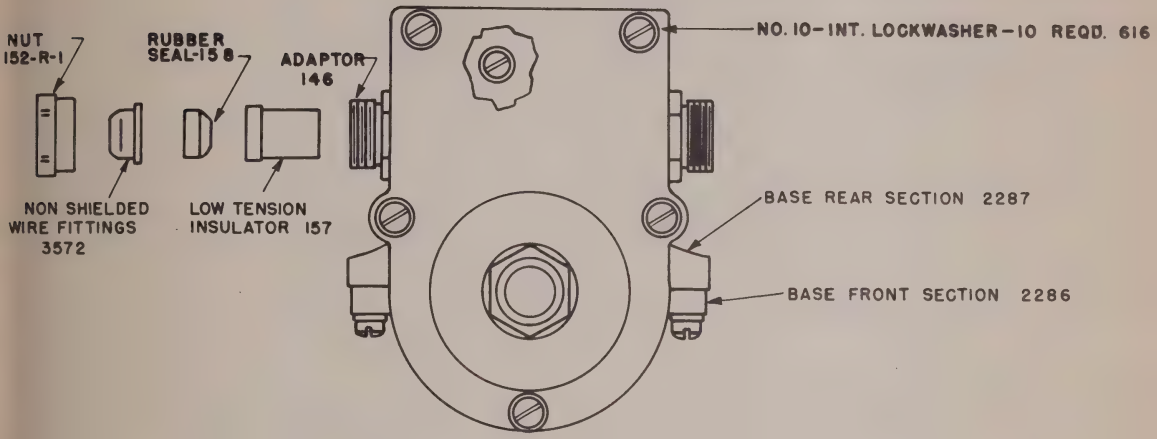
VENDOR: HALLETT MANUFACTURING COMPANY	4035 6 Cylinder Distributor Shield

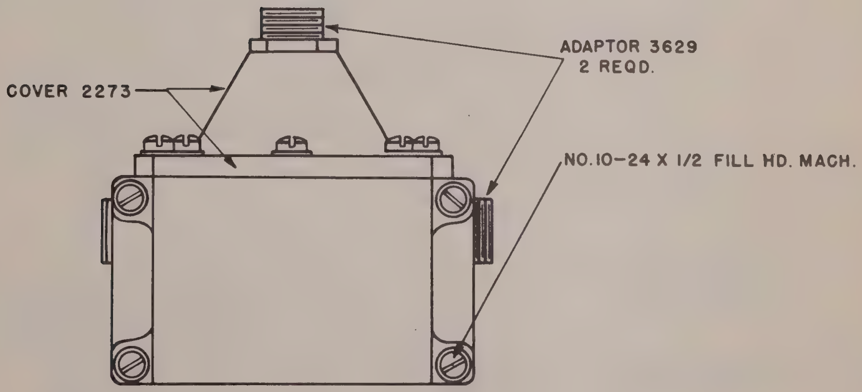


PARTS LIST			
REF.	PART NO.	REQ	DESCRIPTION
	4035	1	Assembly
1	4037	1	Base, Front Half
2	4036	1	Base, Rear Half
3	4038	1	Cover Only
4	4093	1	Low Tension Terminal Shield
5	3620	7	Adaptor
6	2004	1	Air Vent Elbow
7	8148	4	No. 10-24 x 1 Fill. Hd. Machine Screw
8	403	3	No. 10-24 x 5/8 Allen Hd. Set Screw
9	5907	2	No. 12-24 x 3/4 Fill. Hd. Machine Screws
10	5403	2	No. 12-24 x 1 Fill. Hd. Machine Screws
11	616	4	No. 10 I.T. Lockwasher
12	8785	4	No. 12 I.T. Lockwasher

PARTS LIST

VENDOR: HALLETT MANUFACTURING COMPANY	2285 Coil Cap Assembly


NUT
152-R-1
RUBBER
SEAL-158
ADAPTOR
146
NO. 10-INT. LOCKWASHER-10 REQD. 616
NON SHIELDED
WIRE FITTINGS
3572
LOW TENSION
INSULATOR 157
BASE REAR SECTION 2287
BASE FRONT SECTION 2286

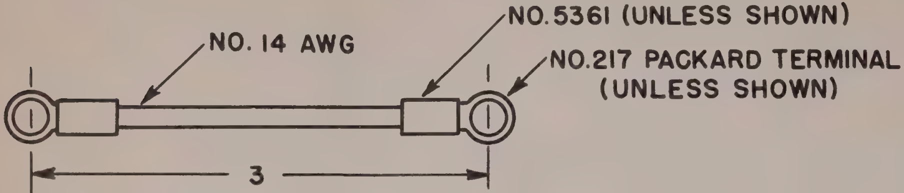

ADAPTOR 3629
2 REQD.
COVER 2273
NO.10-24 X 1/2 FILL HD. MACH.

NOTE:

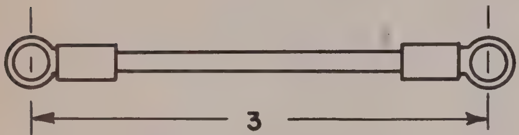
Bored $\frac{2.130}{2.135}$ For Delco-Remy 115327 or Equiv.

PARTS LIST

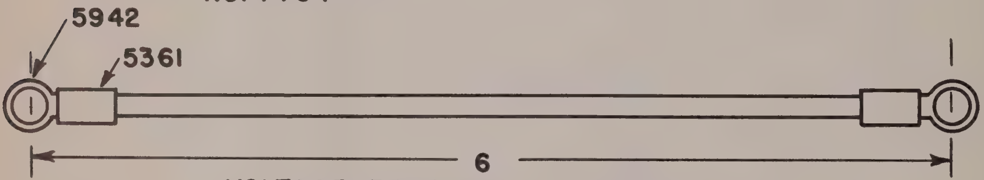
VENDOR: HALLETT MANUFACTURING COMPANY	4465-4468-4469 4 Cylinder Ford Capacitor & Lead Specs


NO. 14 AWG
NO. 5361 (UNLESS SHOWN)
NO. 217 PACKARD TERMINAL (UNLESS SHOWN)
3

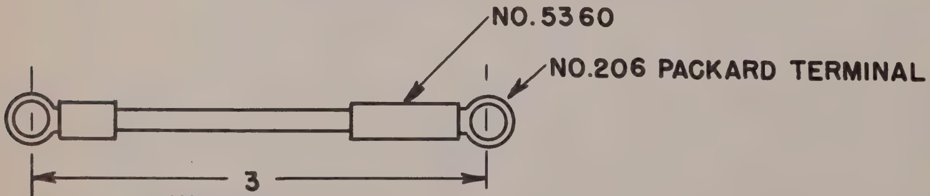
IGNITION COIL
NO. 4456



OIL PRESS. SENDING UNIT
NO. 4464



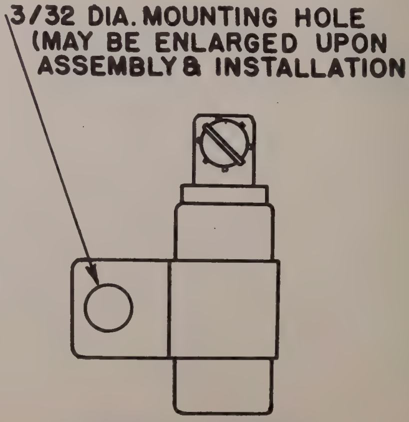
VOLTAGE REGULATOR NO. SEE CHART


NO. 5360
NO. 206 PACKARD TERMINAL
3

GENERATOR
NO. 4466

NOTE:
PART NUMBERS INCLUDE CAPACITOR

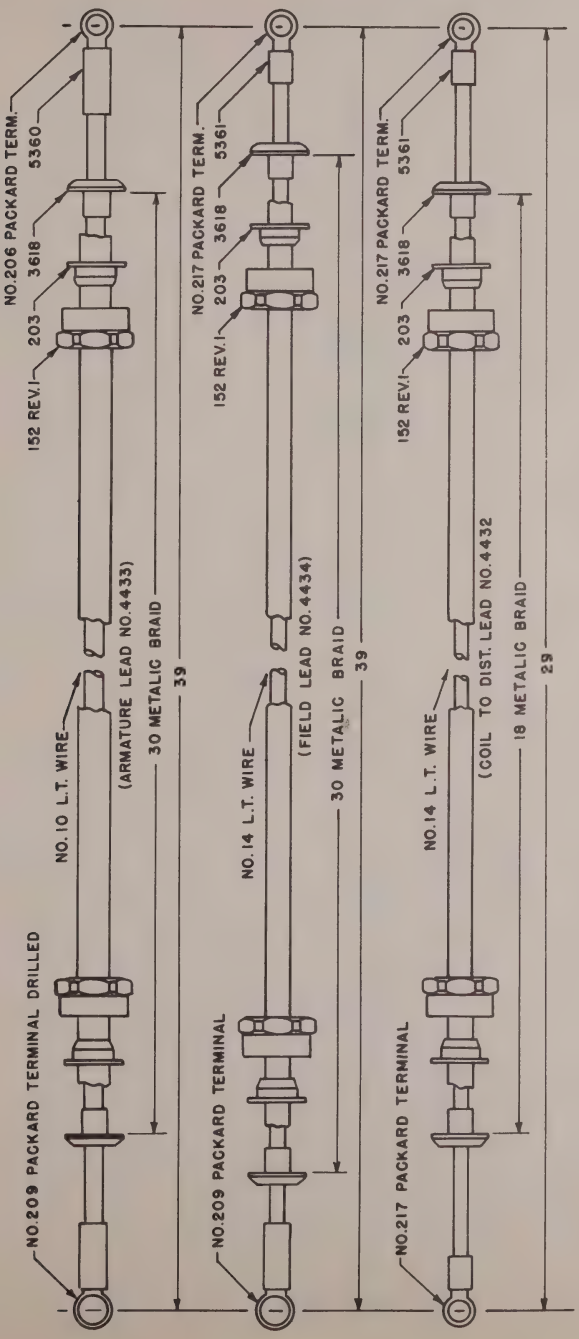
Lead Part No.	Term.	Sleeve
4465	6942	5361
4468	6941-D	5360
4469	6941	5350


3/32 DIA. MOUNTING HOLE
(MAY BE ENLARGED UPON
ASSEMBLY & INSTALLATION

CAPACITOR DATA.
TYPE CA-442
MFD. 100 VDC

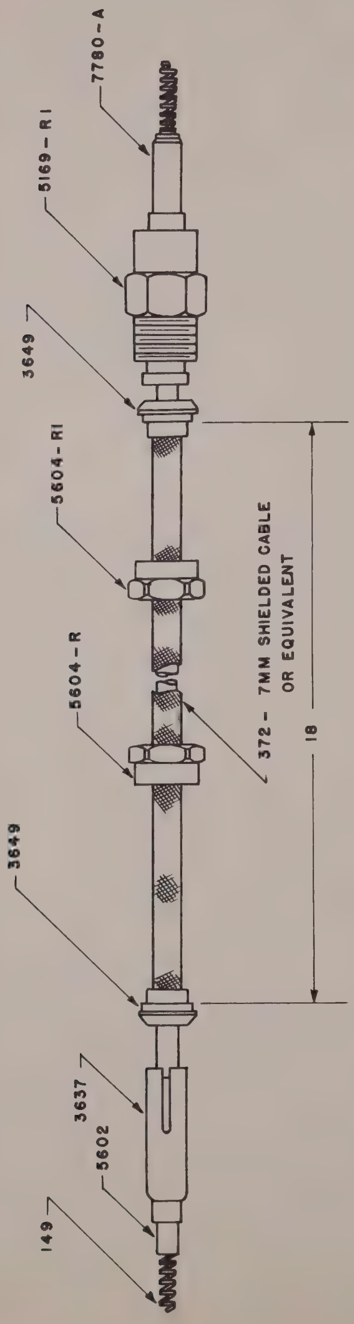
PARTS LIST

VENDOR: HALLETT MANUFACTURING COMPANY	4432-4 Commercial Low Tension Shielded Leads

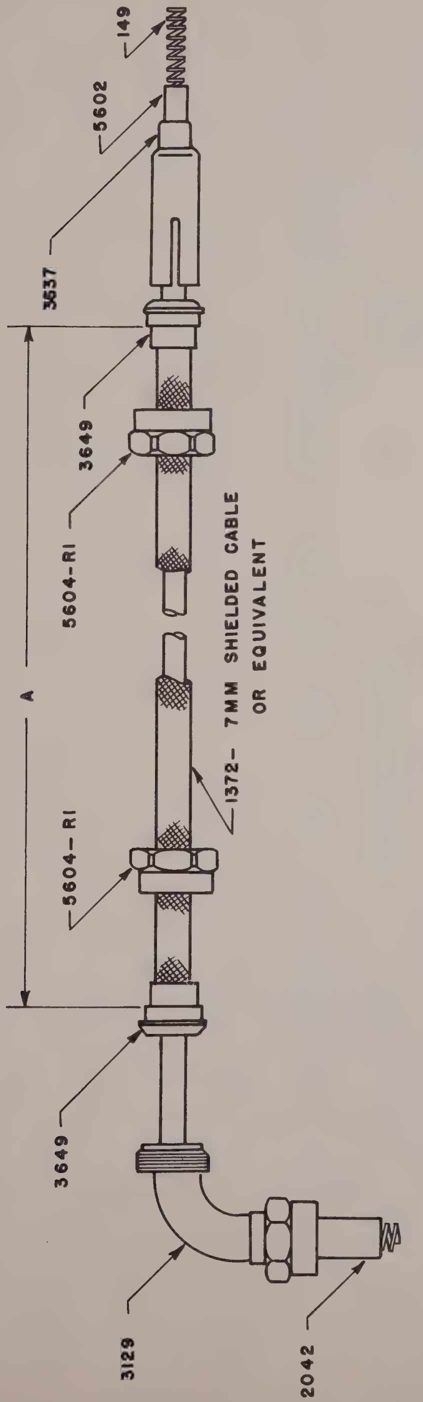

NO.206 PACKARD TERM.
5360
3618
203
152 REV.1
NO.10 L.T. WIRE
(ARMATURE LEAD NO.4433)
30 METALIC BRAID
39
NO.209 PACKARD TERMINAL DRILLED
NO.217 PACKARD TERM.
5361
3618
203
152 REV.1
NO.14 L.T. WIRE
(FIELD LEAD NO.4434)
30 METALIC BRAID
39
NO.209 PACKARD TERMINAL
NO.217 PACKARD TERM.
5361
3618
203
152 REV.1
NO.14 L.T. WIRE
(COIL TO DIST. LEAD NO.4432)
18 METALIC BRAID
29
NO.217 PACKARD TERMINAL

PARTS LIST

VENDOR: HALLETT MANUFACTURING COMPANY	1016 High Tension Shielded Leads For Hendrickson 23861

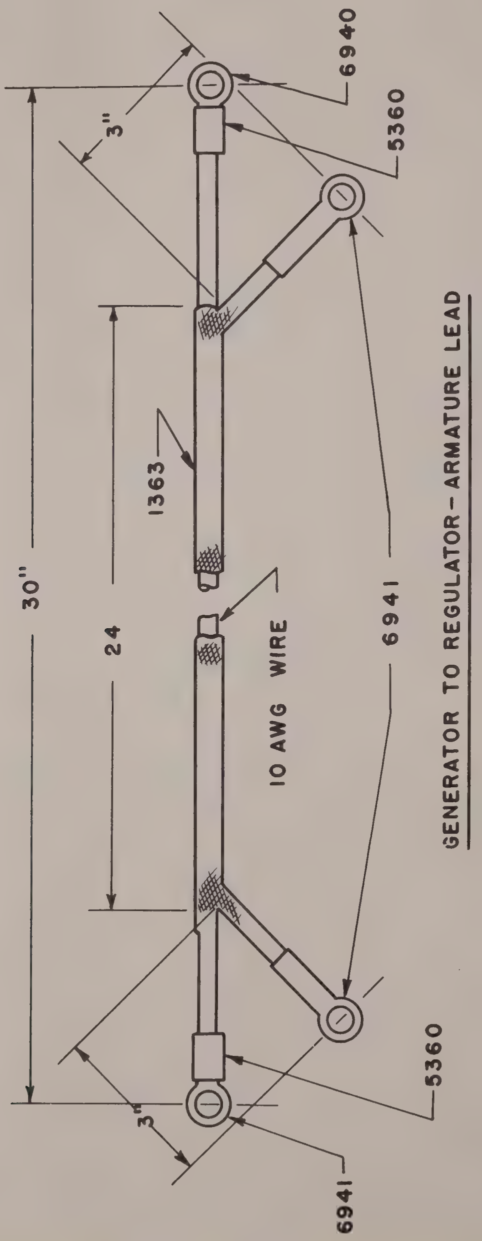

7780-A
5169-R1
3649
5604-R1
5604-R
372- 7MM SHIELDED CABLE OR EQUIVALENT
18
3649
3637
5602
149

VENDOR: HALLET MANUFACTURING COMPANY	PARTS LIST See Chart 1010 — 1015 High Tension Shelded Leads For Hendrickson 23861


149
5602
3637
3649
5604-RI
A
7MM SHIELDED CABLE
OR EQUIVALENT
1372
5604-RI
3649
3129
2042

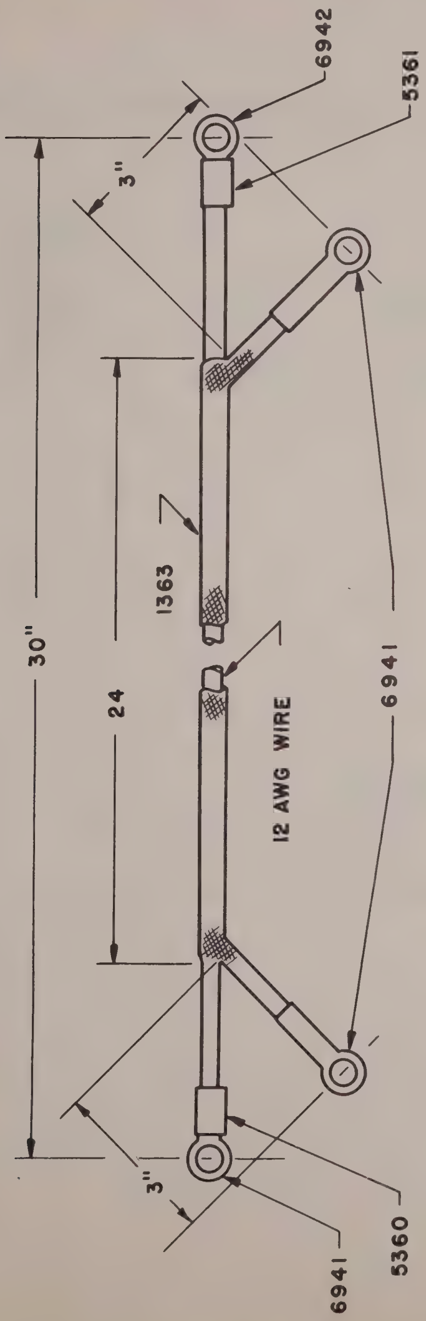
PART NO.	CYL.	A
1010	1	16
1011	2	18
1012	3	20
1013	4	20
1014	5	18
1015	6	16

VENDOR: HALLETT MANUFACTURING COMPANY	PARTS LIST 1293 Shielded Lead Ass'y For Hercules #JXD & JXLD


6940
5360
3"
30"
24
1363
10 AWG WIRE
6941
GENERATOR TO REGULATOR - ARMATURE LEAD
6941
5360
3"
6941

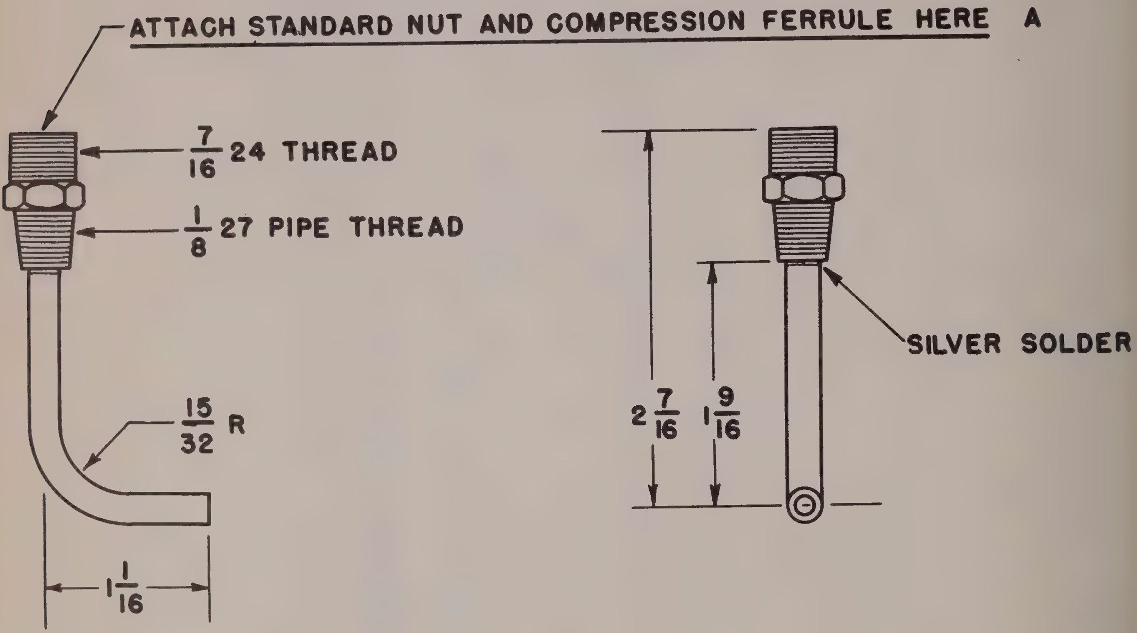
PARTS LIST

VENDOR: HALLETT MANUFACTURING COMPANY	1294 Shielded Lead Assembly For Hercules #JXD & JXLD


6942
5361
3"
30"
24
1363
12 AWG WIRE
6941
3"
6941
5360

GENERATOR TO REGULATOR—FIELD LEAD

VENDOR: HALLET MANUFACTURING COMPANY	PARTS LIST 2511 Pitot Tube Assembly -- Air Vent


ATTACH STANDARD NUT AND COMPRESSION FERRULE HERE A
7/16 24 THREAD
1/8 27 PIPE THREAD
15/32 R
1 1/16
2 7/16
1 9/16
SILVER SOLDER

MATERIAL

FITTING 7/16 HEX BRASS

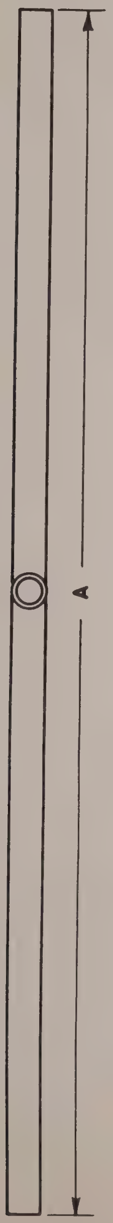
TUBING 3/16 O.D. COPPER

PARTS LIST

VENDOR: HALLETT MANUFACTURING COMPANY

4254
4255 & 4256

Air Vent Tube



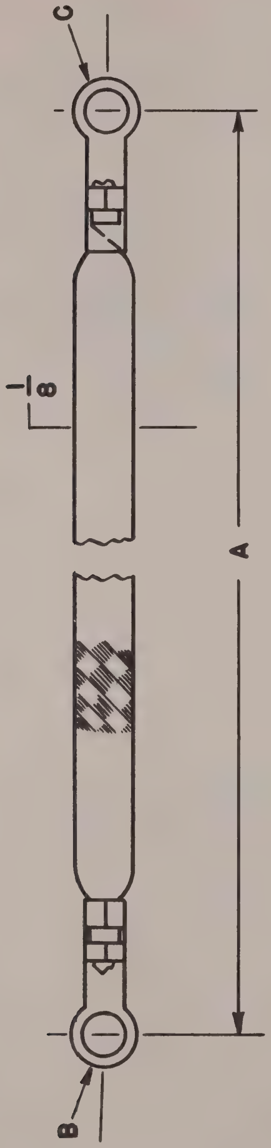
PART NO.	A	ENGINE
4254	50	Packard '6'
4255	55	Packard '8'
4256	36	
4259	40	

NOTES:

1. Material - 1/4 O.D. Copper Tubins
2. To Be Coiled For Shipment

PARTS LIST

VENDOR: HALLETT MANUFACTURING COMPANY	4535-4536 Bond Strap



Part No.	A	B	C
4535	5 3/4	6941-D	6940
4536	10 3/4	6941-D	6940

VENDOR: Powell Muffler Co.	C-3142E2ES MUFFLER

PART NO.	DESCRIPTION	NO. REQ.
C-3142E2ES	Cup Muffler Assembly	
	Cups:	
	#1 First Cup	
	#2, 4, 6, 8, 10, 12 - Blanks	6
	#3, 5, 7, 9, 11, 13 - 3 In. Drawn Hole	6
	#14 Ring	
	INLET HEAD	
	OUTLET HEAD	
	RODS - With Nuts & Washers	3
X-35	3" INLET CLAMP	1
X-35	3" OUTLET CLAMP	1
	2-3/4" 30 Deg. OUTLET SPOUT	1

VENDOR: Spicer Manufacturing Division	9270-9SF PROPELLER SHAFTS & UNIVERSAL JOINTS

PART NO.	DESCRIPTION		NO. REQ.
	Inter-Axle - 27 15/16 In. Overall Length		
	Companion Flange	(For Slip Joint)	1
	Companion Flange	(For Permanent Joint)	1
5-4-1511	End Yoke	(For Slip Joint)	1
5-4-1511	End Yoke	(For Permanent Joint)	1
	Flange Yoke	(For Slip Joint)	1
	Flange Yoke	(For Permanent Joint)	1
5-3-288X	Sleeve Yoke Assembly		1
5-68-54	Sleeve Yoke Plug		1
5-16X	Journal and Bearing Kit		2
	Each Consisting of		
5-5-108X	Journal Cross Assembly		1
5-6-78X	Bearing Assembly		4
	Snap Ring		4
5-70-49	Bearing Cap		4
98-741	Lock Strap		4
5-73-109	Bearing Cap Screw		8
99-29	Zerk Nipple		1
5-76-17	Journal Gasket Retainer		4
5-86-79	Journal Gasket		4
98-1391	Journal Relief Valve		1
4-14-19	Dust Cap		1
5-15-23	Steel Washer		1
5-16-23	Cork Washer		1
	U-Bolt		
	Nut	(For U-Bolt)	
	Lockwasher	(For U-Bolt)	
	Flange Bolt	(For Slip Joint)	
	Flange Bolt	(For Permanent Joint)	
	Nut	(For Flange Bolt)	
	Lockwasher	(For Flange Bolt)	
	End Yoke	(For Solid Shaft)	1
	Shaft Key	(For Shaft Sub-Assembly)	1
	Shaft Nut	(For Shaft Sub-Assembly)	1
	Cotter Pin	(For Shaft Sub-Assembly	1
5-60-224-1012-2318		Shaft Sub-Assembly	1
99-29	Zerk Nipple	(For Sleeve Yoke)	1

VENDOR: Spicer Manufacturing Division	10397-38SF PROPELLER SHAFTS & UNIVERSAL JOINTS

PART NO.	DESCRIPTION	NO. REQ.
	Transfer Case to First Rear Axle - 30 3/4" Overall Length	
	Companion Flange (For Slip Joint)	1
	Companion Flange (For Permanent Joint)	1
	End Yoke (For Slip Joint)	1
	End Yoke (For Permanent Joint)	1
6-2-329	Flange Yoke (For Slip Joint)	1
6-2-319	Flange Yoke (For Permanent Joint)	1
6-3-158X	Sleeve Yoke Assembly	1
6 1/2-68-13	Sleeve Yoke Plug	1
5-17X	Journal and Bearing Kit	2
	Each consisting of	
6-5-138X	Journal Cross Assembly	1
6-6-58X	Bearing Assembly	4
	Snap Ring	4
5-70-49	Bearing Cap	4
98-741	Lock Strap	4
5-73-109	Bearing Cap Screw	8
99-29	Zerk Nipple	1
6-76-17	Journal Gasket Retainer	4
6-86-79	Journal Gasket	4
98-1391	Journal Relief Valve	1
6-14-29	Dust Cap	1
6-15-33	Steel Washer	1
6-16-53	Cork Washer	1
	U-Bolt	
	Nut (For U-Bolt)	
	Lockwasher (For U-Bolt)	
6-73-1227	Flange Bolt (For Slip Joint)	8
6-73-220	Flange Bolt (For Permanent Joint)	8
6-74-11	Nut (For Flange Bolt)	16
6-75-19	Lockwasher (For Flange Bolt)	16
	End Yoke (For Solid Shaft)	1
	Shaft Key (For Shaft Sub-Assembly)	1
	Shaft Nut (For Shaft Sub-Assembly)	1
	Cotter Pin (For Shaft Sub-Assembly)	1
6-60-228-212-2202	Shaft Sub-Assembly	1

VENDOR: Spicer Manufacturing Division	10405-105-SF Propeller Shafts and Universal Joints

PART NO.	DESCRIPTION	NO. REQD.
	Transfer Case to Front Axle - 44 1/2" Overall Length	
	Companion Flange (For Slip Joint)	1
	Companion Flange (For Permanent Joint)	1
	End Yoke (For Slip Joint)	1
6-4-1161	End Yoke (For Permanent Joint)	1
6-2-319	Flange Yoke (For Slip Joint)	1
	Flange Yoke (For Permanent Joint)	1
6-3-158X	Sleeve Yoke Assembly	1
6 1/2-68-13	Sleeve Yoke Plug	1
5-17X	Journal and Bearing Kit	2
	Each Consisting of	
6-5-138X	Journal Cross Assembly	1
6-6-58X	Bearing Assembly	4
	Snap Ring	4
5-70-49	Bearing Cap	4
98-741	Lock Strap	4
5-73-109	Bearing Cap Screw	8
99-29	Zerk Nipple	1
6-76-17	Journal Gasket Retainer	4
6-86-79	Journal Gasket	4
98-1391	Journal Relief Valve	1
6-14-29	Dust Cap	1
6-15-33	Steel Washer	1
6-16-53	Cork Washer	1
	U-Bolt	
	Nut (For U-Bolt)	
	Lockwasher (For U-Bolt)	
6-73-220	Flange Bolt (For Slip Joint)	8
	Flange Bolt (For Permanent Joint)	
6-74-11	Nut (For Flange Bolt)	8
6-75-19	Lockwasher (For Flange Bolt)	8
	End Yoke (For Solid Shaft)	1
	Shaft Key (For Shaft Sub-Assembly)	1
	Shaft Nut (For Shaft Sub-Assembly)	1
	Cotter Pin (For Shaft Sub-Assembly)	1
6-60-228-212-3826	Shaft Sub-Assembly	1

VENDOR: Spicer Manufacturing Division	10271-13SF PROPELLER SHAFTS & UNIVERSAL JOINTS

PART NO.	DESCRIPTION	NO. REQ.
	Transmission to Transfer Case - 24 1/2" Overall Length	
	Companion Flange (For Slip Joint)	1
	Companion Flange (For Permanent Joint)	1
	End Yoke (For Slip Joint)	1
	End Yoke (For Permanent Joint)	1
6-2-319	Flange Yoke (For Slip Joint)	1
6-2-319	Flange Yoke (For Permanent Joint)	1
6-3-158X	Sleeve Yoke Assembly	1
6 1/2-68-13	Sleeve Yoke Plug	1
5-17X	Journal and Bearing Kit	2
	Each consisting of	
6-5-138X	Journal Cross Assembly	1
6-6-58X	Bearing Assembly	4
	Snap Ring	4
5-70-49	Bearing Cap	4
98-741	Lock Strap	4
5-73-109	Bearing Cap Screw	8
99-29	Zerk Nipple	1
6-76-17	Journal Retainer Gasket	4
6-86-79	Journal Gasket	4
98-1391	Journal Relief Valve	1
6-14-29	Dust Cap	1
6-15-33	Steel Washer	1
6-16-53	Cork Washer	1
	U-Bolt	
	Nut (For U-Bolt)	
	Lockwasher (For U-Bolt)	
6-73-220	Flange Bolt (For Slip Joint)	8
6-73-220	Flange Bolt (For Permanent Joint)	8
6-74-11	Nut (For Flange Bolt)	16
6-75-19	Lockwasher (For Flange Bolt)	16
	End Yoke (For Solid Shaft)	1
	Shaft Key (For Shaft Sub-Assembly)	1
	Shaft Nut (For Shaft Sub-Assembly)	1
	Cotter Pin (For Shaft Sub-Assembly)	1
6-60-228-212-1526	Shaft Sub-Assembly	1

PARTS LIST

VENDOR: Hendrickson Motor Truck Co. General Radiator Company	R-3 General Radiator

PART NO.	DESCRIPTION	NO. REQ.
R-3	Radiator (General Radiator Co.)	
BA-5113	Radiator Mounting Assembly	1
AE-5236	Rubber Washer	8
AE-5237	Steel Washer	4
1/2"-13 N.C.	Hex. Head Nut	4
1/2"-13 N.C. 1 1/4 long	Hex. Head Bolts (Drilled for Cotter Pin)	4
3/32 x 1-1/8 long	Cotter Pin	4
BE-5642	Stay Rod Assembly	1
1/2" - 20 NF	Hex Nut	6
1/2"	Lock Washer	2
BE-5981	Upper Connection	1
BE-4008	Lower Connection	1
AE-5692	Upper Hose	1
AE-5693	Lower Hose	1
M-36	Hose Clamp (Aero-Seal)	4

VENDOR: Ross Gear & Tool Company	TA-72324 Steering Gear

PART NO.	DESCRIPTION	NO. REQ.
504941	Housing Assembly	1
TA-712016	Housing (OA-6 1/4 TB-4-3/8)	1
069501	Bushing	2
8645-13	End Cover Assembly	1
402109	End Cover	1
082069-13 1/4	End Cover Tube	1
032113	Oil Seal	1
8865-45-3/4	Cam and Wheel Tube Assembly w/bearings	1
8864-45-3/4	Cam and Wheel Tube Assembly	1
TA-713012	Cam	1
092111-35-3/4	Wheel Tube	1
E-20	Wheel Nut	1
400020	Ball Cup	2
400005	Retaining Ring	2
400014	Balls, 3/8 in. dia.	28
8758-3/4-5/16	Jacket Tube Assembly w/upper cover	1
8757-33-13/16	Jacket Tube Assembly	1
097011-33-3/4	Jacket Tube	1
066988	Bearing Unit Complete	1
066989	Bearing Assembly Only	1
401103	Spring	1
028110	Spring Seat	1
TA-666002	Upper Cover	1
8692-10 1/4	Lever Shaft Assembly	1
8691-10 1/4	Lever Shaft w/nut and lockwasher	1
TA-714000 10 1/4	Lever Shaft (w/1-036006)	1
025003	Lever Shaft Nut	1
None	Lockwasher 1-1/8 in. Med. Pos. Type	1
503982	Set of stud-roller bearing units (consists of 2 #044982 matched units)	1

VENDOR: Ross Gear & Tool Company

PART NO.	DESCRIPTION	NO. REQ.
	The only serviceable individial parts of the bearing units are:	
	025009 nut	2
	028015 prolonged washer	2
438172-33	Steering Arm Assembly	1
438172	Steering Arm	1
042033	Ball Stud	1
504176	Housing Side Cover Assembly	1
TA-715000	Housing Side Cover	1
021065	Adjusting Screw	1
025031	Lock Nut	1
033042	Upper Cover Shim .002 In.	Var.
033036	Upper Cover Shim .003 In.	Var.
033037	Upper Cover Shim .010 In.	Var.
None	3/8 In. Standard Pipe Plug	2
020139	Side Cover Cap Screw, (3/8 - 16 x 1 1/2 Hex. Hd.)	8
020142	Upper Cover Cap Screw, (3/8 - 16 x 1 Hex. Hd.)	4
None	3/8 In. medium lockwasher	12
TA-719000	Side Cover Gasket	1

VENDOR: Fuller Manufacturing Co.	5-A-43 (576) TRANSMISSION

Part No.	Description	No. Req'd
C-206	Case & Clutch Housing Assembly	1
A-219	Clutch Pedal Adjusting Arm Assembly	1
1642	Shifting Bar Housing Cover Gasket	1
1980	Clutch Pedal Shaft	1
2237	Speedometer Opening Plug	1
2401	Brake Shaft Hole Plug	1
4734	Clutch Bearing Carrier	1
4920	Speedometer Gear Replacement	1
5434	Mainshaft Slotted Nut	1
5435	Mainshaft Universal Joint Washer	1
6347	Splined Mainshaft	1
8116	Shifting Bar Housing Cover	1
7835	Mainshaft Pilot Roller Bearing	1
A-287	Oil Pipe Assembly Consisting of the following parts assembled: 1 3230 Oil Pipe Nipple 1 3231 Oil Pipe Elbow 1 3232 Oil Pipe 1 3233 Oil Pipe Coupling	1
A-321	Clutch Release Yoke Assembly Consisting of the following parts assembled: 1 2772 Clutch Release Yoke 2 X-7-603 3/8 - 24 x 1 Hex. Hd. Bolt	1
A-585	Mainshaft Gear & Bushing Assembly Consisting of the following parts assembled: 1 5332 Mainshaft Gear Bushing 1 5495 Mainshaft 3rd. Speed Gear	1
A-586	Mainshaft Gear & Bushing Assembly Consisting of the following parts assembled: 1 4364 Mainshaft Gear Bushing 1 5493 Mainshaft 4th. Speed Gear	1
1051	Countershaft Front Bearing Cover Gasket	1
1064	Position Finder Spring	3
1149	Countershaft Front Bearing Cover	1
1565	Clutch Hand Hole Cover	1
1634	Interlock Cross Pin	1
1638	Reverse Idler Shaft Lock	1
1684	P.T.O. Cover Gasket	2
1819	Locking Wire for Yoke Screw	1
1929	Oil Retaining Thimble	2

Part No.	Description	No. Req'd
1956	Name & Number Plate	1
2840	Cover for P. T. O. Opening	2
2939	Short Thimble for Yoke Bar Hole	4
2947	Long Thimble for Yoke Bar Hole	1
2962	Gear Shift Lever Bell	1
3198	Latch Rod Washer	1
3220	Shifting Yoke Locking Screw	4
3398	Gear Shift Lever Housing	1
3418	Reverse Stop Sleeve	1
3437	Reverse Stop Sleeve Pin	1
3501	Short Clutch Pedal Shaft	1
3875	Clip for Reverse Sleeve	1
4369	Mainshaft 4th. Speed Gear Sleeve	1
4398	Hand Hole Cover Plate	1
4418	Shift Lever Stop Plate	1
4425	Oil Pipe Tension Spring	1
4461	Front Bearing Cover Gasket	1
4504	Countershaft Snap Ring	1
4590	Mainshaft Rear Bearing Washer	1
5147	1st. & Reverse Speed Shifting Block	1
5319	Rear Bearing Cover & Speedometer Housing	1
5320	Front Bearing Cover	1
5321	Countershaft Rear Bearing Cover	1
5322	4th. & Direct Speed Shifting Yoke	1
5323	2nd. & 3rd. Speed Shifting Yoke	1
5324	1st. & Reverse Speed Shifting Yoke	1
5326	4th. & Direct Speed Yoke Bar	1
5327	2nd. & 3rd. Speed Yoke Bar	1
5328	1st. & Reverse Speed Yoke Bar	1
5330	Low Reverse Idler Shaft	1
5341	1st. Speed Sliding Gear	1
5342	Reverse Idler Gear	1
5345	Countershaft P. T. O. Gear	1
5348	Countershaft Rear Bearing Cover Gasket	1
5349	Countershaft Front Bearing Spacer	1
5350	Countershaft Front Bearing Washer	1
5358	Rear Bearing Cover Gasket	1
5412	Shifting Bar Housing Gasket	1
5490	Clutch Shaft & Drive Gear	1
5491	Countershaft Drive Gear	1
5492	Countershaft 4th. Speed Gear	1
5494	Countershaft 3rd. Speed Gear	1
5497	2nd. Speed Sliding Gear	1
5573	Shifting Bar Housing	1
6074	Mainshaft Sliding Clutch	1
6332	Mainshaft Washer Key	1
6333 or 6334	Mainshaft 4th. Speed Gear Washer	1
8062	Drive Gear Bearing Nut	1

VENDOR: Fuller Manufacturing Co.	5-A-43 (576) TRANSMISSION	
Part No.	**Description**	**No. Req'd**
8304	Countershaft with 1st., 2nd. & Reverse Speed Gear	1
8337	Countershaft Rear Bearing Nut	1
X-3-600	3/8 Plain Lockwasher	4
X-3-605	3/8 Lockwasher (Shakeproof #1320-00-00)	12
X-6-3	#404 Woodruff Key	1
X-6-11	#607 Woodruff Key	1
X-6-E	#1210 Woodruff Key	4
X-8-509	5/16 - 18 x 1/2 Rd. Hd. Cap Screw	6
X-8L-600	3/8 - 16 x 1 Hex. Hd. Cap Screw	18
X-8L-604	3/8 - 16 x 1-1/4 Hex. Hd. Cap Screw	7
X-8-605	3/8 - 16 x 3 Hex. Hd. Cap Screw	2
X-8-606	3/8 - 16 x 5/8 Hex. Hd. Cap Screw	12
X-8-607	3/8 - 16 x 2-1/4 Hex. Hd. Cap Screw	1
X-8-612	3/8 - 16 x 1 Hex. Hd. Cap Screw - Special	1
X-12-1201	3/4 Pipe Plug - Square	1
X-12-2001	1-1/4 Pipe Plug - Square	1
X-13-206	#7 x 5/16 "Z" Type Self-Tapping Screw	2
X-13-302	3/16 x 3/4 Countersunk Hd. Iron Rivet	2
X-14-800	1/2 Steel Ball	3
X-14-1200	3/4 Steel Ball	2
212MFG	Drive Gear Ball Bearing	1
308MFG	Countershaft Rear Ball Bearing	1
309SG	Mainshaft Rear Ball Bearing	1
4532	Low Reverse Idler Roller Bearing	2
4694	Clutch Release Bearing	1
5478	Countershaft Front Roller Bearing	1
	ASSEMBLY No. C-206	
	CASE & CLUTCH HOUSING ASSEMBLY	
1631	Transmission Case Dowel Pin	2
1632	Clutch Housing Stud	6
1712	Straight Plug	1
8040	Clutch Housing - #2 Flange	1
8121	Transmission Case	1
X-1-1000	5/8 - 18 NF Plain Nut	6
X-3-1000	5/8 Plain Lockwasher	6
6734	Selector Shaft Stub	2
6747	Drag Link Stub	2
	MODEL RC CONTROL (528)	
1075	Gear Shift Lever Ball	1
1512	Control Cover Top Plate	1

Part No.	Description	No. Req'd
	MODEL RC CONTROL (528) (Continued)	
1513	Control Cover Top Plate Gasket	1
1819	Locking Wire for Lever Screw	1
1956	Name & Number Plate	1
2271	Gear Shift Lever Pivot Pin	1
2536	Gear Shift Lever Spring	1
2538	Gear Shift Lever Washer	1
4553	Ball Joint Spring	2
4597	Inner Shift Lever	1
4598	Outer Shift Lever	1
4599	Selector Yoke	2
4600	Control Cover	1
4601	Ball Joint Socket	2
4602	Ball Joint Plug	2
4603	Selector Shaft Bracket	1
4606	Selector Shaft Bushing	2
4607	Ball Joint Seat	4
4608	Selector Shaft Felt Washer	2
4609	Gear Shift Lever Housing	1
4612	Shifting Shaft	1
4671	Gear Shift Lever Boot	1
5549	Position Finder Spring	1
8394	Gear Shift Lever	1
X-1-500	5/16 - 24 NF Plain Nut	1
X-1-600	3/8 - 24 NF Plain Nut	3
X-1-1401	7/8 - 14 Special Jam Nut	2
X-3-500	5/16 Plain Lockwasher	1
X-3-600	3/8 Plain Lockwasher	3
X-4-414	1/8 x 1-3/4 Cotter Pin	2
X-6-11	#607 Woodruff Key	2
X-7-601	3/8 - 24 x 1-3/4 Hex. Hd. Bolt	2
X-7-605	3/8 - 24 x 2 Hex. Hd. Bolt	1
X-7-626	3/8 - 24 x 1-3/4 Hex. Hd. Bolt - Special	1
X-8-509	5/16 - 18 x 1/2 Rd. Hd. Cap Screw	4
X-8L-600	3/8 - 16 x 1 Hex. Hd. Cap Screw	3
X-12-601	3/8 Pipe Plug - Square	1
X-13-206	#7 x 5/16 "Z" Type Self-Tapping Screw	2
X-14-800	1/2 Steel Ball	1

VENDOR: The Timken-Detroit Axle Co.	T-76 TRANSFER CASE

Part No.	Description	No. Req'd
1898-R-70	Ball -- Declutch Shifter Shaft Lock	
1898-E-57	Ball--Fear Shift Shaft Lock	
7609	Bearing--Declutch Shaft	
3979	Bearing--Driven Shaft Fwd. - Cone	
49585	Bearing--Driven Shaft Rear - Cone	
3920	Bearing--Driven Shaft Fwd. - Cup	
49520	Bearing--Driven Shaft Rear - Cup	
49585	Bearing--Idler Shaft - Cone	
49520	Bearing--Idler Shaft - Cup	
7209	Bearing--Main Drive Gear Idler	
7610	Bearing--Main Shaft Fwd.	
7609	Bearing--Main Shaft Rear	
S-1614-X	Bolt--Gear Shift Shaft Fork	
S-1713	Bolt--Transfer Case and Cover	
A-1199-J-166	Breather--Transfer Case - Assembly	
1825-E-57	Bushing--Driven Shaft	
3826-C-185	Cage--Declutch Shaft Bearing	
3838-H-86	Cage--Main Shaft Fwd. Bearing	
A-3875-C-133	Case--Transfer and Cover Assembly	
2848-W-23	Clutch--Declutch Shaft Driving	
2848-V-22	Clutch--Declutch Shaft Sliding	
2848-Q-95	Clutch--Power Take Off Drive	
A-3866-P-354	Cover--Declutch Shaft Bearing	
3866 R-382	Cover--Driven Shaft Rear Bearing	
3855-H-60	Cover--Fear Shift	
A-3866-S-383	Cover--Idler Shaft Fwd. Bearing	
3866-Q-381	Cover--Idler Shaft Rear Bearing	
3866-T-384	Cover--Main Shaft Rear Bearing	
1898-S-201	Elbow--Trans. Case Oil Filter	
2849-P-94	Fork--Declutch Shifter Shaft	
2849-R-96	Fork--Gear Shift Shaft	
2808-V-360	Gasket--Declutch Shaft Bearing Cage	
2808-P-94	Gasket--Declutch Shaft Cage Cover	
2808-Z-384	Gasket--Driven Shaft Bearing Cover	
2808-H-216	Gasket--Gear Shift Cover	
2808-X-362	Gasket--Idler Shaft Fwd. and Rear Cover	
2808-Y-363	Gasket--Main Shaft Fwd. Cover	
2808-W-361	Gasket--Main Shaft Rear Cover	
2808-A-365	Gasket--Transfer Case and Cover	
3892-Q-719	Gear--Drive-Low Speed-Low Ratio 1.72 - 1	
3892-S-721	Gear--Driven	
3892-U-723	Gear--Idler	
3892-T-722	Gear--Main Drive	
3892-R-720	Gear--Sliding - Low Speed	

VENDOR: The Timken-Detroit Axle Co.	T-76 Transfer Case

Part No.	Description	No. Req'
16-X-65	Key-Driven Gear	
16-X-65	Key--Idler and Low Speed Gear	
16-X-23	Key--Main and Driven Shaft	
2847-S-293	Lever--Declutch Shift	
N-26	Nut--Gear Shift Fork Bolt	
14-X-57	Nut--Main and Driven Shaft	
N-17	Nut--Transfer Case and Cover Bolt	
5-X-349	Packing--Declutch Shifter Shaft	
5-X-287	Packing--Gear Shift Shaft	
1846-F-136	Pin--Declutch Shift Lever	
2847-B-106	Plate--Transfer Case Breather	
1850-Q-43	Plug--Declutch Shaft Cage Oil	
1850-Y-51	Plug--T.C. Mounting Dowel Hole	
1850-E-57	Plug--T.C. Mounting Stud Hole	
P-212	Plug--Transfer Case Oil Drain	
P-112	Plug--Transfer Case Oil Filler	
1846-B-2	Plunger--Gear Shift Lock Spring	
1805-W-75	Retainer-Declutch Shifter Shaft Packing	
1805-Z-26	Retainer--Gear Shift Shaft Packing	
S-865	Screw--Declutch Driving Clutch	
26-X-52	Screw--Declutch Shift Fork	
10-X-156	Screw--Declutch Shift Lever	
3-X-146	Screw--Declutch Shift Lock Spring	
S-266	Screw--3/8" - 16-X - 3/4	
S-2610	Screw--3/8" - 16-X - 1-1/4	
S-279	Screw--7/16" - 14-X - 1-1/8	
S-2710	Screw--7/16" - 14-X - 1-1/4	
S-2714	Screw--7/16" - 14-X - 1-3/4	
S-2719	Screw--7/16" - 14-X - 2-3/8	
S-1810	Screw--1/2" - 20-X - 1-1/4	
S-2811	Screw--1/2" - 13-X 0 1-3/8	
A-1805-Z-104	Seal--Declutch Shaft Oil	
A-1805-L-168	Seal--Driven and Main Shaft Oil	
3880-T-46	Shaft--Declutch	
2843-F-110	Shaft--Declutch Shifter	
A-3880-N-326	Shaft--Driven	
2843-R-122	Shaft--Gear Shift	
3880-L-324	Shaft--Idler	
3880-M-325	Shaft--Main Drive	
2803-U-619	Shim--Driven Shaft Rear Cover - Thin	
2803-V-620	Shim--Driven Shaft Rear Cover - Med.	
2803-W-621	Shim--Driven Shaft Rear Cover - Thick	
2803-N-612	Shim--Idler Shaft Fwd. and Rear Cover - Thin	
2803-P-614	Shim--Idler Shaft Fwd. and Rear Cover - Med.	

PARTS LIST

VENDOR: The Timken-Detroit Axle Co.	T-76 TRANSFER CASE

Part No.	Description	No. Req'd
2803-Q-615	Shim--Idler Shaft Fwd. and Rear Cover - Thick	
2803-R-616	Shim--Main Shaft Fwd. Cover - Thin	
2803-S-617	Shim--Main Shaft Fwd. Cover - Med.	
2803-T-618	Shim--Main Shaft Fwd. Cover - Thick	
2847-Y-311	Slinger--Driven Shaft Oil	
2847-Y-311	Slinger--Main Shaft Oil	
1844-S-175	Spacer--Idler Shaft Gear	
1844-R-174	Spacer--Main Drive Gear Bearing	
1844-T-176	Spacer--Speedometer Gear	
2858-S-45	Spring--Declutch Shifter Lock	
2858-A-1	Apring--Gear Shift Lock	
1829-W-257	Washer--Declutch Shifter Lock Screw	
1829-B-392	Washer--Driven and Idler Shaft	
1829-C-393	Washer--Main Drive Gear Bearing	
1829-A-391	Washer--Main Shaft Rear Bearing	
1829-D-394	Washer--Power T.O. Clutch	
1829-W-257	Washer--Power T.O. Clutch Screw	
WA-16	Washer--3/8"	
WA-17	Washer--7/16"	
WA-18	Washer--1/2"	

VENDOR: Hendrickson Motor Truck Co.	Tool Kit

PART NO.	DESCRIPTION	NO. REQ.
3353	Tool Kit	
	End Wrenches	
	1. 3/8 x 7/16	1
	2. 1/2 x 9/16	1
	3. 5/8 x 3/4	1
	4. 7/8 x 15/16	1
	5. 1-1/16 x 1-1/4	1
	Screw Drivers	
	1. w/3" Blade	1
	2. w/6" Blade	1
	7" Chisel	1
	1 lb. Machinist's hammer	1
	9" Drift Punch	1
	Pair Pliers	1
	Box Wrench - 9/16" x 5/8"	1
4023-E	Lever Type Grease Gun w/6638A Adapter	1
	Front Axle Sleeve Nut Wrench	1
	Rear Axle Sleeve Nut Wrench	1
	Motor Crank	1
E-129A	12 ton Hydraulic Jack	1
	Fire Extinguisher - 1 qt. size	1

VENDOR: Stewart-Warner	Dash Panel Instuments

PART NO.	DESCRIPTION	NO. REQ.
440069	Ammeter	1
441035	Fuel Guage	1
442101	Heat Indicator	1
444085	Oil Gage	1
444086	Air Pressure Gage	1
529 CL	Speedometer	1
65600	Speedometer Cable (170" long)	

MODEL 40

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CONTINENTAL ENGINE

ITEM 1 INTRODUCTION

This instruction book is for the information and guidance of the operators of the WAYNE CRANE shovel, trench hoe, dragline, crane, clamshell,pile driver and magnet. It not only tells you what you can expect of the machine, but what is necessary for you to maintain your efficiency as a good operator.

A study and application of the information contained herein will repay you in trouble-free performance. These instructions are the result of practical field operations.

The WAYNE CRANE with its various attachments was designed and developed after many years' experience in the excavating and material-handling fields.

With relatively few changes, the basic machine can be converted from one to any of the other classes of service in a comparatively short time, the essential differences being mainly in attachments. The operations will differ with the classes of service for which the machine is equipped. However, there are several operations that are common to all classes of work, and it will simplify matters to mention them. In all cases the engine, engine clutch, swinging and the boom hoist operations are the same regardless of the type of attachment.

ITEM 2 GENERAL INSTRUCTIONS TO OWNER AND OPERATOR

TO THE OWNER

You are entitled to the best performance and the lowest cost operation that is obtainable from this WAYNE CRANE.

The degree in which this is obtained depends largely on the maintenance and care provided by you. A thorough knowledge and understanding of the instructions in this book will enable you to get a maximum of efficiency and low cost operation. The thorough reading of this manual should be required of every WAYNE CRANE operator.

If there is any special information not contained herein regarding the care and operation of the machine desired by you or your operator, we will gladly furnish it upon request. When writing, please give us the serial number and model number of your machine and the part numbers of the pieces under discussion.

TO THE OPERATOR

Read the engine manufacturer's instruction book carefully.

Be sure to check the radiator before starting the engine, use pure soft water for summer operation and with the proper anti-freeze for cold weather operation.

Be sure to check the engine crank case and all gear cases. If additional grease or oil is needed, be sure to use the proper specified grade or weight that we recommend.

It is a very good practice to check your WAYNE CRANE over at least once a week wiping up excessive oil or grease that may have accumulated. At this time it is also advisable to check over the machinery, correcting any broken or worn parts. This will increase your production. Be wise and cut your down time.

Be sure to check your brakes and clutches daily. Improper adjustment will wear them out. Proper care and adjustments will be outlined in the following pages.

If at any time it becomes necessary to remove any gear guards or safety shields, be sure to replace them before starting the machine. CAUTION: Do not attempt any adjustments with the machinery in operation.

Before leaving your machine for the day, be sure you are leaving it in a safe place and under safe conditions. Do not allow your machine to freeze in mud. In freezing weather, run your machine onto solid ground or onto timbers or mats before leaving. If your truck is allowed to freeze in, serious damage may result to the propelling mechanism.

Be sure and check your lubrication chart in this manual and follow it closely, using only the specified amounts and weights.

IMPORTANT

This manual is your permanent guide for care and operation of your WAYNE CRANE. Keep it in a safe place and don't lose it as new operators may be employed from time to time and will require its use.

GENERAL INSTRUCTIONS

The owner should pass along to the operator any additional operational bulletins that may be issued from time to time and attach them to this manual for future reference. It is always our desire to make any improvements that may help cut your operating cost and improve the maintenance of your WAYNE CRANE.

ITEM 3

CONTROLS

BEFORE attempting to operate an excavator, the operator should make a careful study of the operating levers and control system. He should become thoroughly acquainted with the purpose of all levers and controls.

No. 1. Swing Lever - Sitting in the operator's seat and facing forward, control #1 operates the reversing clutches on the horizontal swing shaft. When the lever is pushed forward from the operator, the revolving base will rotate to the right, and when the lever is pulled back toward the operator, the revolving base will rotate to the left. To stop swinging in either direction, partially engage opposite clutch by reversing lever. When the lever is in a vertical position, the swing clutches are in a neutral position.

No. 2. Master Clutch Lever - If the clutch slips and fails to carry the load after the hand lever has been thrust into the engaged position, it is probably due to the friction plates being too loose. Refer to engine clutch adjustment.

No. 3. Boom Hoist Clutch Lever - The boom hoist is hydraulic operated. In order to raise the boom, pull on boom hoist lever, and to lower the boom, push the lever from you. This lever, being spring loaded, will return to neutral position (or off position) when released.

No. 4. R.H. Drum Brake Pedal - This pedal applies braking pressure to the R.H. drum. To lower load slowly, release brake pedal.

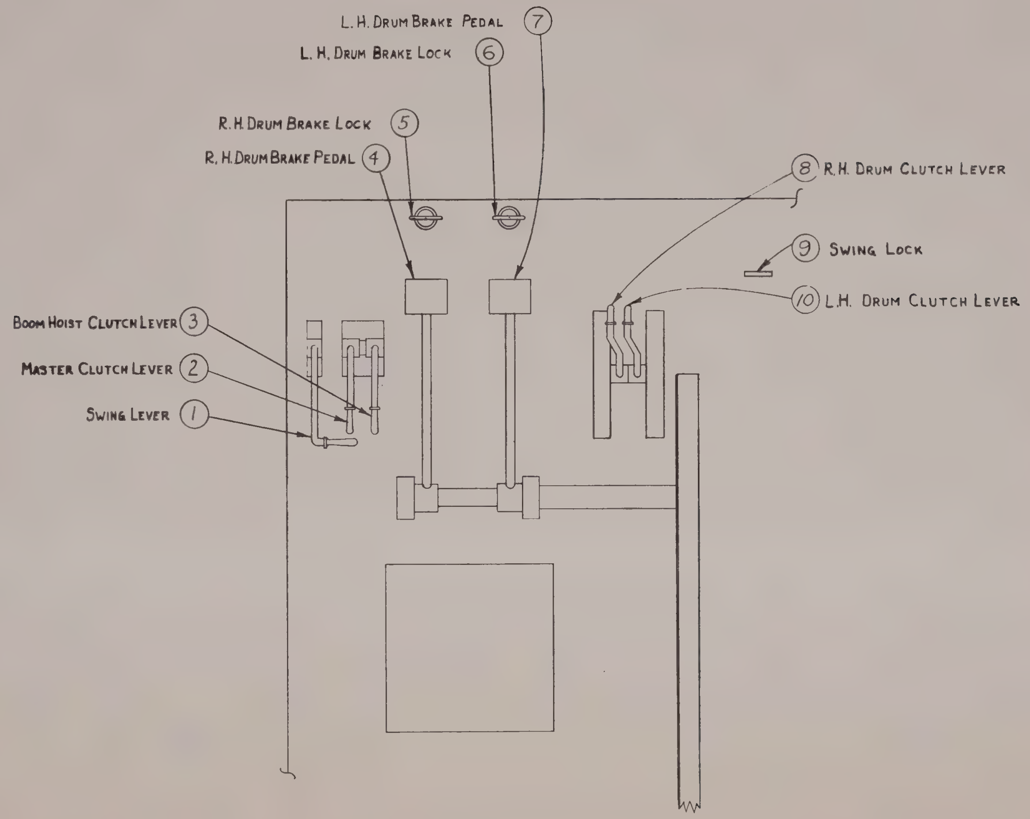
No. 5. R.H. Drum Brake Lock - This is to lock Control 4 in a fixed position.

No. 6. L.H. Drum Brake Lock - This is to lock Control #7 in a fixed position.

No. 7. L.H. Drum Brake Pedal - This pedal applies braking pressure to the L.H. drum. To lower load slowly, release brake pedal.

No. 8. R.H. Drum Clutch Lever - This is the digging and retract lever or closing lever for clamshell operation. This control operates the clutch for the right-hand drum. To hold load in a fixed position, set drag brake by pushing forward on the R.H. Drum Brake Pedal, Control #4, simultaneously releasing Control #8. To maintain load in a fixed position, set R.H. Drum Brake Lock, Control #5. To release load, apply R.H. Drum Brake Pedal, Control #4, and pull up on R.H. Drum Brake Lock, Control #5.

CONTROL LEVER DIAGRAM


L. H. Drum Brake Pedal ⑦
L. H. Drum Brake Lock ⑥
R. H. Drum Brake Lock ⑤
R. H. Drum Brake Pedal ④
⑧ R.H. Drum Clutch Lever
⑨ Swing Lock
⑩ L.H. Drum Clutch Lever
Boom Hoist Clutch Lever ③
Master Clutch Lever ②
Swing Lever ①

ITEM 3 - CONTROLS CONT.

No. 9. Swing Lock - This control is a locking device which is used to prevent the revolving base from swinging when the excavator is traveling. When control is in up position, swing lock is engaged.

No. 10. L.H. Drum Clutch Lever - When this lever is pulled back toward the operator, the hoist clutch is engaged. This rotates the hoist drum. To hold load in a fixed position, engage L.H. Drum Brake Pedal, Control #7. To maintain load in a fixed position, release L.H. Drum Brake Lock, Control #6. To release load for lowering, apply L.H. Drum Brake Pedal, Control #7, and pull L.H. Drum Brake Lock, Control 6.

ITEM 4

STARTING MACHINE

To start the machine, first check the oil level in the crankcase. Check the coolant level in the radiator, adding if necessary. BE SURE THAT THE ENGINE CLUTCH IS DISENGAGED. The starter button is located on the instrument panel which is mounted on the engine. The throttle is a hand lever located on the cab wall behind the right-hand cab window. The choke is located on the instrument panel. Pull the throttle out about a quarter of its travel and push the starter button after the igniton switch has been turned on. If the engine does not start within a reasonable time, release the starter button and pull the choke out a little. This operation is similar to starting any automobile or truck. NOTE: If machine has Waukesha engine equipped with Waukesha governor, the control is located below the throttle control.

CAUTION: Do not attempt to start machine by punching starter button. Be sure to engage starter button firmly; otherwise starter may jam. In time this causes excessive wear on flywheel teeth.

Do not choke the engine any more than is absolutely necessary and push the choke control in as soon as the engine is running smoothly. Always allow the engine to warm up for a few moments before applying any load or engaging the engine clutch. After the engine is running smoothly, be sure that all of the operating levers are in a neutral position before engaging the engine clutch.

ITEM 5

ENGINE AND FUEL TANK

Always consult the engine manufacturer's manual that is furnished with the crane when making any adjustments or selecting the proper grade and weight of oil.

The engine is mounted on the gas tank which is constructed of heavy welded steel plate and pressure tested for your safety. It has a capacity of 40 gals. Never allow your fuel tank to stand empty overnight or for long periods of inactivity because condensation of moisture in the air takes place and results in difficult starting and poor engine performance. We would recommend that you allow your tank to run low every six months and then drain and refill.

ITEM 6

ENGINE CLUTCH

The engine or master clutch is a heavy-duty clutch and with good care will

ITEM 6 - ENGINE CLUTCH CONT.

give you prolonged and satisfactory results. All grease fittings are on the exterior of the clutch housing, making it unnecessary to remove any plates or covers when greasing.

Adjustment is made by removing the cover plate from the bell housing and pulling or realeasing adjusting locks. Then turn adjusting rings to right until operating lever requires a distinct pressure to engage clutch.

CAUTION: Do not operate machine with a loose clutch as this will hasten the replacement of the clutch discs. For lubrication, consult the lubrication chart in this manual.

ITEM 7 RIGHT ANGLE DRIVE

The mechanism in the "right angle drive" is self-contained and should operate trouble-free indefinitely if kept filled to the proper level with a high grade of oil. The capacity is approximately 6 lbs. Use S.A.E. 90 for temperatures below 10° F. and S.A.E. 140 for temperatures above 10° F. The unit should be drained and refilled every six months.

ITEM 8 HORIZONTAL SWING

The horizontal swing shaft contains Timken roller bearings which have been properly spaced and loaded at the factory. No other adjustment is necessary other than the 20" clutches. This has been outlined under clutch adjustment. The bevel swing pinions mounted on this shaft need only the proper application of crator compound to be used as outlined in the lubrication chart.

ITEM 9 BOOM HOIST

The boom hoist is operated by a hydraulic motor receiving its power from a hydraulic pump drive by a V belt from a pulley on the right angle drive. The belt itself should be kept at a good tension so as not to allow slippage on the pulleys. Adjustment is made by loosening the hold down bolts on the base and shifting pump until the belt is reasonably tight.

A safety brake is mounted on the worm gear shaft and is only intended as a drag brake to stop reverse action of the shaft in lowering the boom. Therefore this brake should never be tightened down securely on the drum. A light pressure is all that is required.

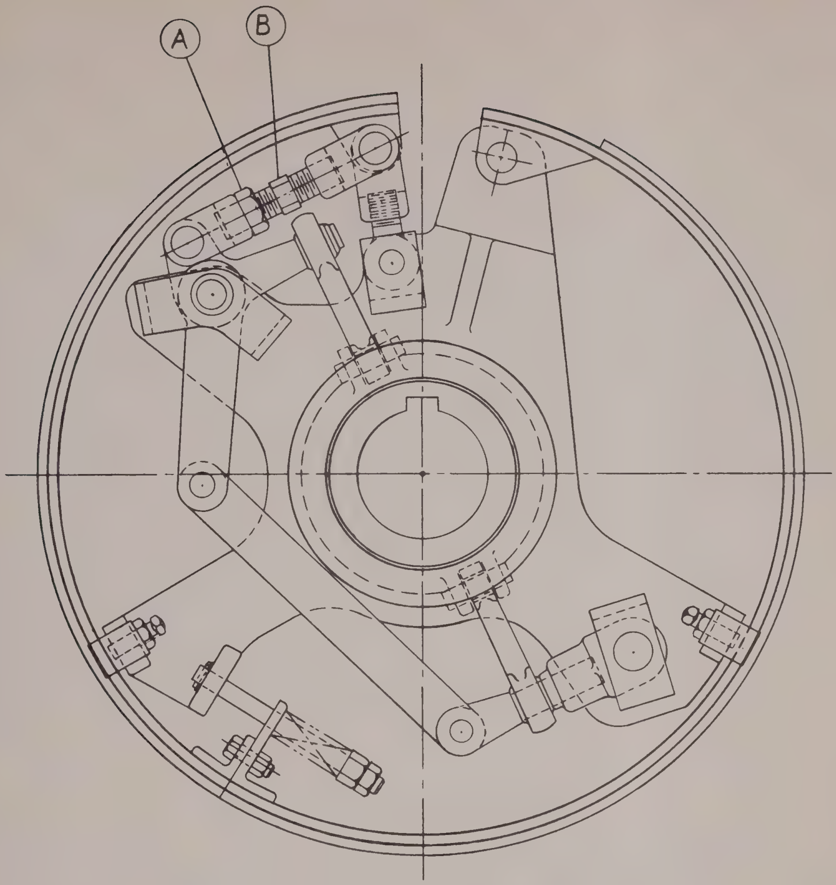
CAUTION: Be sure that hydraulic tank is never allowed to run dry of oil as this will cause the vanes on the pump to burn stopping the pump action. The pump receives its lubrication from this oil.

ITEM 9 - BOOM HOIST CONT.

The method used in aligning a new belt on the boom hoist power pack is to loosen the four hold down bolts on the power pack base plate and also the adjusting bolt on the stay brace between the right angle drive and the pump mounting bracket sufficiently to remove the old belt. The new belt can then be installed while the assembly is loose.

After the belt is in place, alignment can be made by tightening the adjusting screw and the hold down bolts. The belt should be set at a tension of not more than 1/4" depression taken at the center of the belt mid-way between the two pulleys. When the power pack is properly aligned the belt will run centrally on both pulleys and will not touch the flange on either the large or small pulley.

CAUTION: Be sure, after the new belt is properly aligned, that the adjusting bolt on the stay brace is set so that vibration is eliminated between the right angle drive and the boom mounting bracket.



ITEM 14

CLUTCH ADJUSTMENT

These clutches are all the same as far as size and design are concerned. There is only one simple adjustment necessary for their perfect, smooth operation. The adjustment is accomplished by loosening nut (A) and tightening nut (B). WHEN THE PROPER ADJUSTMENT HAS BEEN ACCOMPLISHED, THEN NUT (A) MUST BE TIGHTENED TO HOLD THE ADJUSTMENT. Some operators prefer the clutch to toggle in. Others prefer to hold the clutch in with the hand lever. If the clutch is to toggle in, it requires a slightly looser adjustment than otherwise. These clutches are very smooth and positive in operation and, therefore, do not need frequent adjustment except in the breaking-in period.

To adjust the two centering set screws, tighten set screw until the band comes in contact with the drum. Then back off 1 1/2 turns and lock. This will result in about 1/8" clearance.

There is a band lifter spring provided to keep the band from riding the brake drum when the brake is released.

ITEM 15 DRUM BRAKE ADJUSTING AND CARE OF LINING

The drum brakes have been designed to give considerable safety factor and will hold capacity loads with very little effort on the part of the operator. Therefore, it is not necessary to tighten the brakes to the extent that they cannot be locked easily. Always be sure that your brakes will hold the load you are lifting. Adjustment is made very easily by the bolt in the center of the brake band at the top of the drum. The jam nut should be backed off and the take-up nut tightened until desired pressure is obtained. After completing adjustment, always tighten the jam nut as vibration may work the take-up nut loose.

In damp or rainy weather it is always best to work the clutches and brakes several times before attempting to lift or swing. Failure to do so may result in injury to other workmen. Always keep the clutch and brake linings free from grease and oil. Never operate with worn-out linings as the rivets will score the drum surface making it very difficult to keep new linings in good condition. Remember a good operator is a safe operator. Never operate the machine with the clutches too loose or too tight as this will cause the linings to become glazed, causing inefficient operation and harder work for the operator.

ITEM 16 ADJUSTMENT OF CONICAL ROLLER

There are four of these conical rollers which hold the revolving base in proper relation to the ball race upon which it rests. They should be adjusted as the case demands. To adjust the rollers, take out two (2) cap screws and move flange to the right or left whichever the adjustment may demand. Clearance between top of roller and underside of flange on chassis should not be more than 1/16" at any time and should definitely never exceed 1/8".

ITEM 17 BALL RACE AND RING GEAR

In order to simplify the dismantling of the crane, the ball race and ring gear have been made removable. This also allows repairs to be made faster should it become necessary to do so. The ring gear teeth and pinion should be coated every eight hours of operation. Consult your grease chart. Inspect the drive pinion and ring gear periodically. If you are operating under dusty or dirty conditions, the ball race should be flushed with new grease oftener than prescribed. Always use the correct grease recommended by us.

ITEM 22

WIRE ROPE

GENERAL

Your WAYNE CRANE has been designed with large rope sheaves and drums, and the leads are straight and free from reverse bends. This results in working conditions most favorable to long life and efficient service from the ropes. The service given by a rope depends in a large part upon the manner in which the operator uses the machine and the care he gives the ropes. Apply the following suggestions and you will get maximum rope service.

How to handle wire rope. Handle rope reels and coils carefully. Do not drop them on hard, sharp surfaces or pry them from drums with pinch bars. Support a rope reel so that the end may be carried from the reel, unwinding it instead of stripping it from the reel. If the rope is delivered in a coil, loosen the end and roll it upright on the ground to unwrap it. Never kink the rope or put any strain on it while it is twisted. When a new rope is fitted to a drum, allow at least one full turn to remain on the drum when the line is extended to its maximum reach.

A new rope should be broken in when first fitted to a drum. This is best accomplished by operating the machine for a few minutes with no load in the dipper or bucket. This gives the rope an opportunity to become set to the drum and the sheaves. Never allow the rope to unwind from the drum with no load on it, and then apply full power with the bucket loaded. This snaps the rope and might break it. Never allow the rope to unreel completely from the drum, as it will cause a reverse bend at the socket and the first heavy pull will break it.

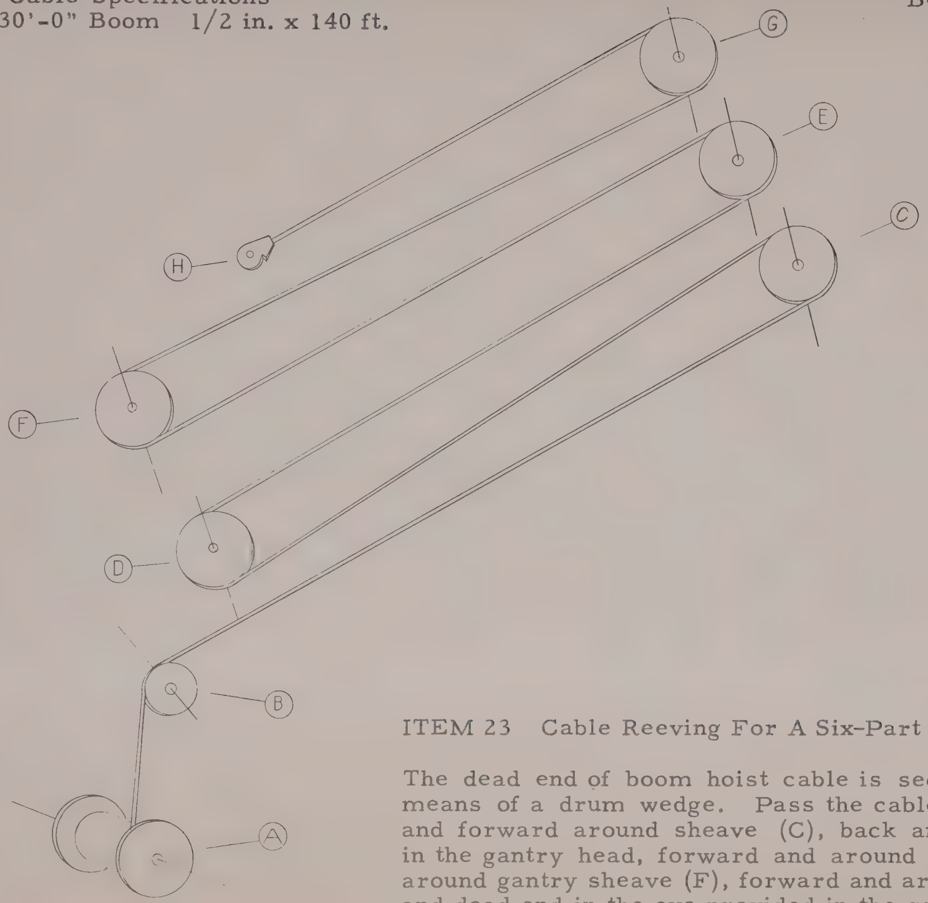
LUBRICATION OF WIRE ROPE

The wear upon a running rope is both external and internal, and as it is impossible in the manufacture of rope to provide lubrication for the entire life of the rope, it becomes necessary to use a lubricant of such a nature that it will penetrate to the center of the rope. A heavy-bodied oil with graphite is a good lubricant and is cheaper than and as satisfactory as any of the proprietary lubricants. A heavy viscous preparation covering the outside of the rope does not give the internal lubrication necessary.

The principal causes of deterioration of wire rope are heavy abrasion, overstrain, bending and corrosion. Evidence of abrasion is shown by the outside wires wearing thin in a short time. If the wires are slightly worn, breaking off squarely and sticking out all over the rope, there is evidence of an overload or severe handling.

Cable Specifications
Crane - 30'-0" Boom 1/2 in. x 140 ft.

BOOM HOIST CABLE ARRANGEMENT



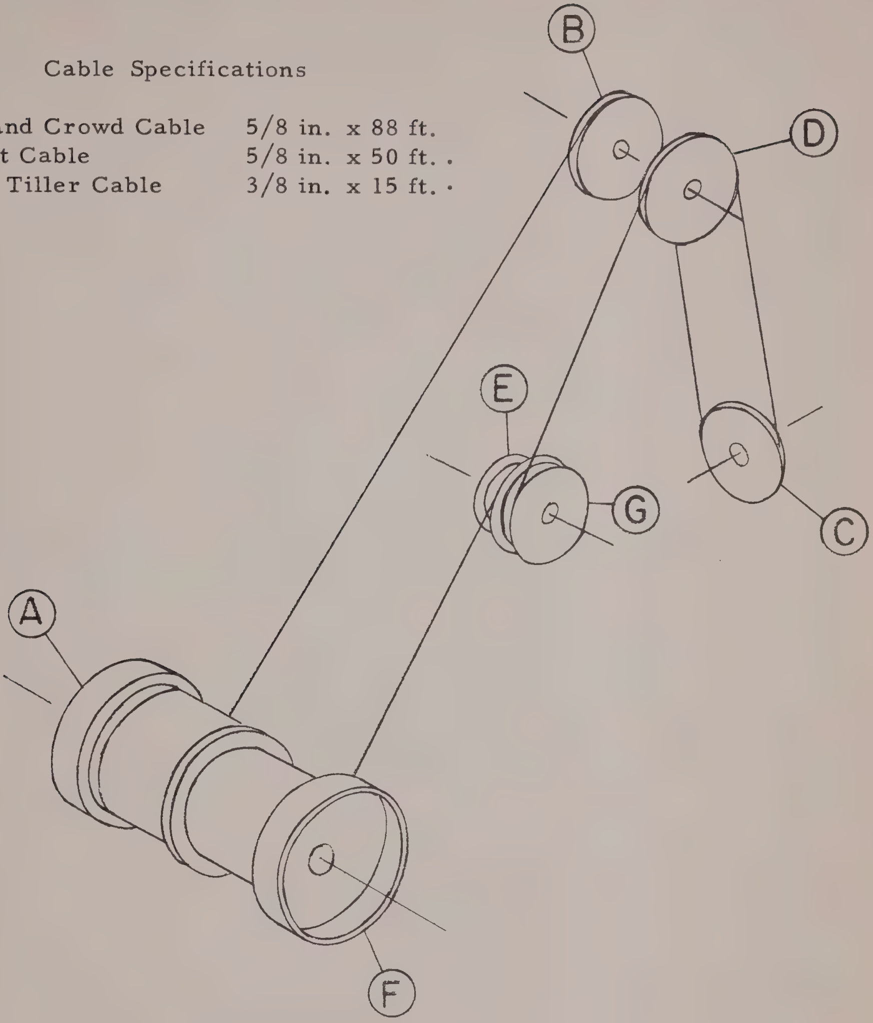
ITEM 23 Cable Reeving For A Six-Part Line for 30'-0" Boom

The dead end of boom hoist cable is secured to drum (A) by means of a drum wedge. Pass the cable up over sheave (B) and forward around sheave (C), back and around sheave (D) in the gantry head, forward and around sheave (E), back and around gantry sheave (F), forward and around sheave (G), back and dead end in the eye provided in the gantry head frame.

SHOVEL CABLE REEVING

Cable Specifications

Hoist and Crowd Cable	5/8 in. x 88 ft.
Retract Cable	5/8 in. x 50 ft.
Trip - Tiller Cable	3/8 in. x 15 ft.



ITEM 24

HOW TO REEVE SHOVEL ROPES
(Single Purpose Boom)

The hoist and crowding line is dead-ended on the left-hand drum (A) and passed over the left-hand boom point sheave (B) down and around the dipper padlock sheave (C), up and over the right-hand boom point sheave (D), and after given six (6) wraps around the shipper shaft drum (G), is dead-ended on drum by passing the line through a hole provided in the drum and applying a rope clip.

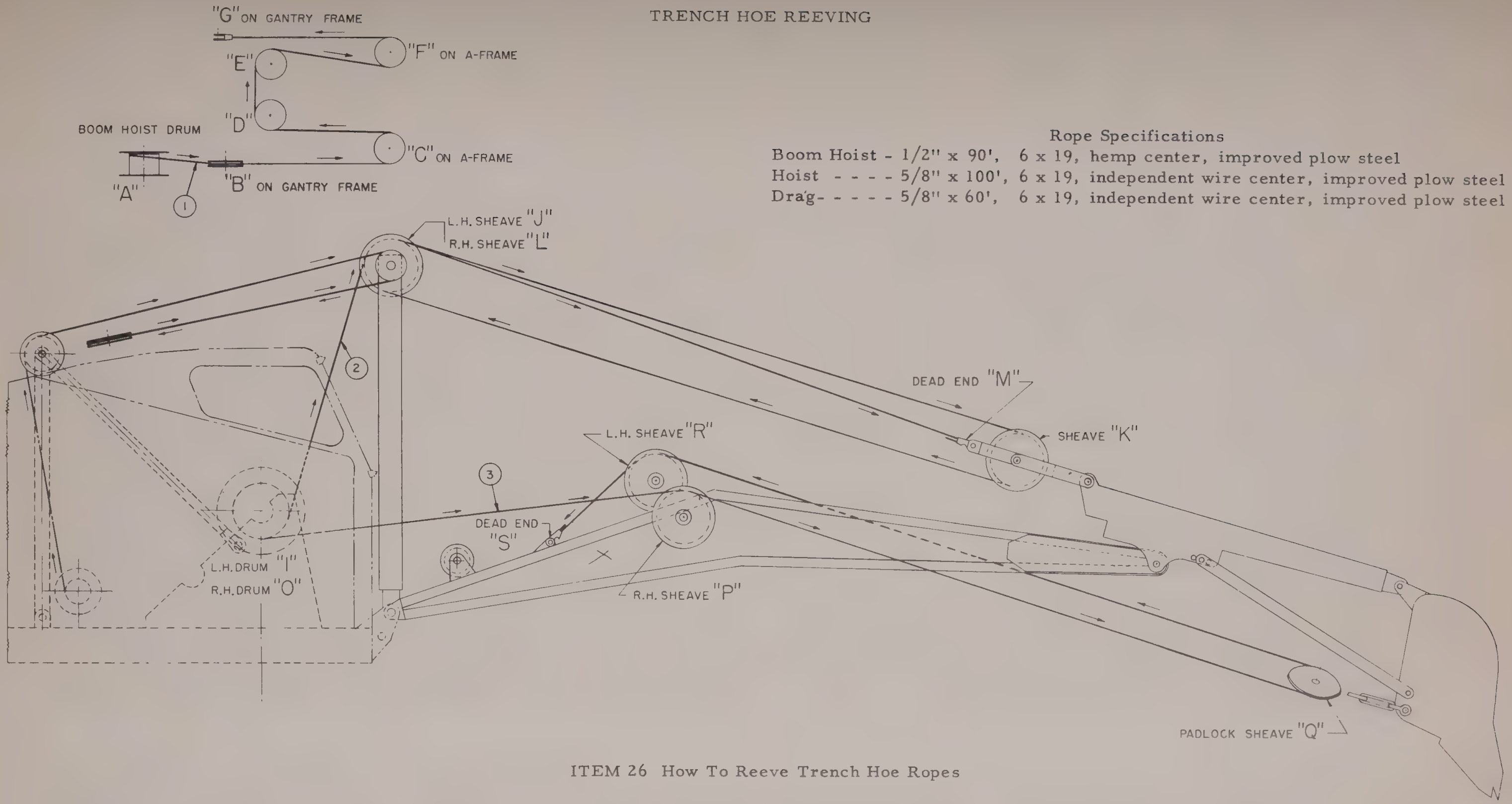
ITEM 25

TRENCH HOE OPERATION

The trench hoe was developed to excavate trenches, but in recent years has found wide acceptance in the contracting field for use in digging basements and foundations. It is a fast and accurate machine which is capable of digging at extreme depths at a short radius.

The attachments consist of the same boom as used by the shovel, a short "A" frame and bucket arm. The bucket is attached to the end of the bucket arm and digs its material by scooping back toward the machine. The boom is raised or lowered by a cable reeved on the left-hand drum and the digging by a cable reeved on the right-hand drum over sheaves in the boom. The trench hoe is operated much in the same manner as the dragline insofar as the levers are concerned.

TRENCH HOE REEVING


"G" ON GANTRY FRAME
"F" ON A-FRAME
"E"
"D"
BOOM HOIST DRUM
"C" ON A-FRAME
"A"
"B" ON GANTRY FRAME
①
L.H. SHEAVE "J"
R.H. SHEAVE "L"
②
DEAD END "M"
SHEAVE "K"
L.H. SHEAVE "R"
③
DEAD END "S"
L.H. DRUM "I"
R.H. DRUM "O"
R.H. SHEAVE "P"
PADLOCK SHEAVE "Q"

Rope Specifications

Boom Hoist - 1/2" x 90', 6 x 19, hemp center, improved plow steel
Hoist - - - - 5/8" x 100', 6 x 19, independent wire center, improved plow steel
Drag- - - - - 5/8" x 60', 6 x 19, independent wire center, improved plow steel

ITEM 26 How To Reeve Trench Hoe Ropes

A-Frame Rope

Lead rope 1 from back side of drum "A" up over sheave "B", forward and around sheave "C", back and around sheave "D", across and around sheave "E", forward over sheave "F", back and dead end at "G", on gantry head frame with wedge socket.

Hoist Rope

Fasten rope 2 in left hand drum "I" by means of wedge. Lead rope up and over sheave left hand sheave "J" on A-frame forward to and around sheave "K" on bucket arm, back and around right hand sheave "L" on A-frame forward to wedge socket and dead end "M" on bucket arm.

Drag Rope

Fasten rope 3 in right hand drum "O" by means of wedge. Lead rope forward over top of sheave "P", down and around padlock sheave "Q", back up and over sheave "R", back to wedge socket and dead end at "S".

ITEM 27 CHANGE FROM SHOVEL TO TRENCH HOE (Dual Purpose Boom)

To change from shovel to trench hoe the stop clamp is removed from the dipper stick. Stick is removed by reeving and then releasing retract cable. Lift bucket slightly and pull out of saddle bearing.

Then install 5/8" x 54' pull cable on right drum up and over top right sheave of "A" frame and around center of boom. Shovel crowd and shipper shaft assembly is then removed and trench hoe shipper shaft assembly is installed.

Raise "A" frame nearly straight and then, with right-hand drum, raise boom high enough to line up with hinge bearing on trench hoe arm, with the bucket standing perpendicular. Line up and install boom point shaft and boom point sheave. Install one bronze washer on each side of boom point. Tighten the 1/2" Allen set screws in the boom point. Also install and spread 1/2" cotters in boom point shaft and boom foot pin. Remove pull cable from boom and reeve hoisting and pull cables as per operator's manual.

ITEM 28 CHANGE FROM TRENCH HOE TO SHOVEL (Dual Purpose Boom)

First place trench hoe bucket in vertical position so bucket rests on teeth and heel firmly. Then remove both hoisting and pull cable. Leave pull cable attached to drum and take pull cable up and over right-hand sheave of "A" frame, then around 15' boom at center making a solid loop. Use cable clamps from dead end of pull cable.

This enables raising and lowering of boom to permit removal of boom point shaft and boom point sheave, bucket and bucket arm. After removal of boom point shaft, supports should be placed at far end of boom, holding boom approximately level. Pull cable and "A" frame cable are then removed. "A" frame is removed by unbolting the split bosses on "A" frame feet.

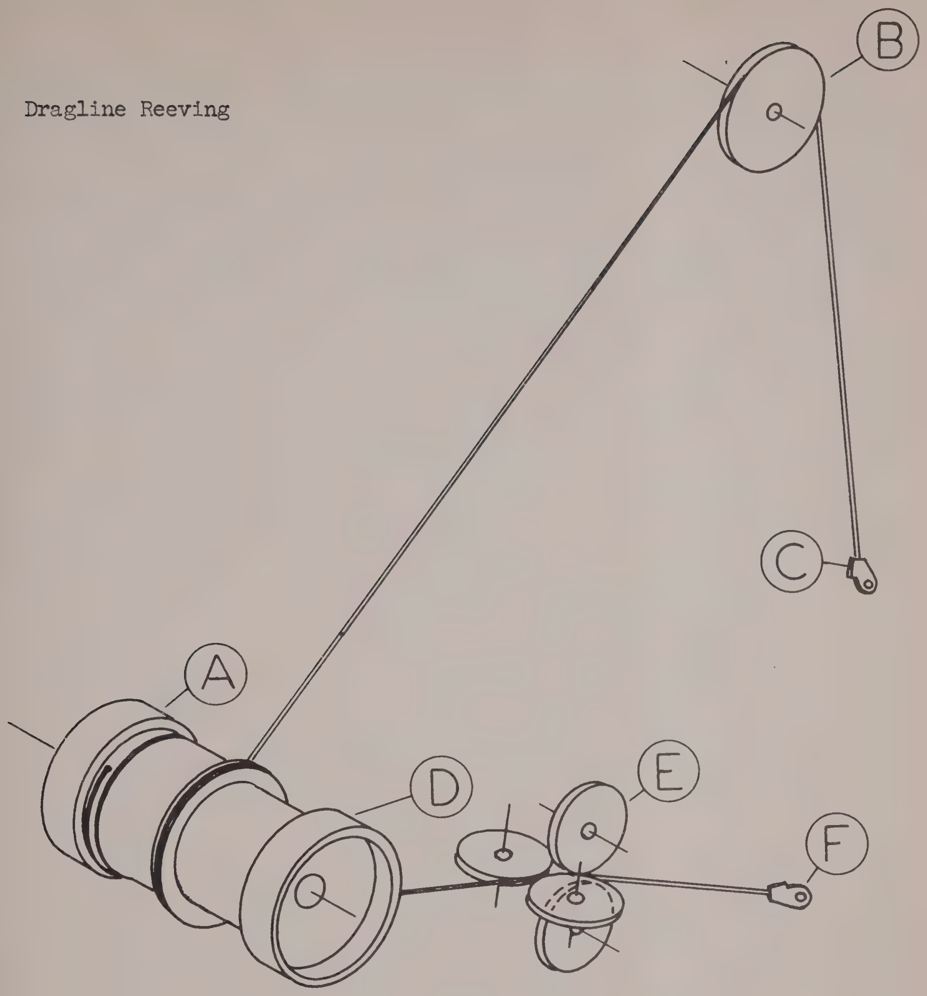
A heavy plank gives support for a jack placed under lower end of boom. By raising or lowering this jack, the boom foot pin can be removed. As the pin is pulled, a short shaft should be inserted in the boom foot, on the side which is left free, to prevent boom from getting out of line. This short shaft should come only flush with inside of boom foot bracket. The long boom foot pin should be pulled back until it is also flush with inside of the bracket on the opposite side.

The trench hoe shipper shaft assembly is then removed and shovel shipper shaft assembly installed, using the same bolt holes for both shaft assemblies.

The boom point shaft assembly is then installed and 1/2" x 112' boom hoist cable reeved. Then attach 5/8" x 84' hoisting and crowding cable to left-hand drum and over large left-hand sheave in boom point, then through padlock sheave on shovel bucket and dead end cable to right-hand boom point sheave, using one clamp.

Raise boom to 40° angle. Using hoist drum, lift the dipper and dipper handle assembly, which can then be balanced by hand. All bronze inserts may be removed from the saddle block to facilitate the installation of the

Dragline Reeving



Cable Specifications

Hoist	5/8 in. x 85 ft.
Dragline	5/8 in. x 50 ft.

ITEM 29

HOW TO REEVE DRAGLINE ROPES

The dragline hoist rope is first dead-ended to the left-hand drum (A). The other end of the line is led up and over the left-hand boom point sheave (B), and is dead-ended in the hoist rope socket (C) on the bucket dump line. The dragline is dead-ended to the right-hand drum (D). The other end of the line is led through the fairlead sheaves (E), as shown, and finally dead-ended to the pulling bail rope socket (F) on the bucket chain. The dump line and chain are part of the dragline bucket equipment and are supplied with the bucket.

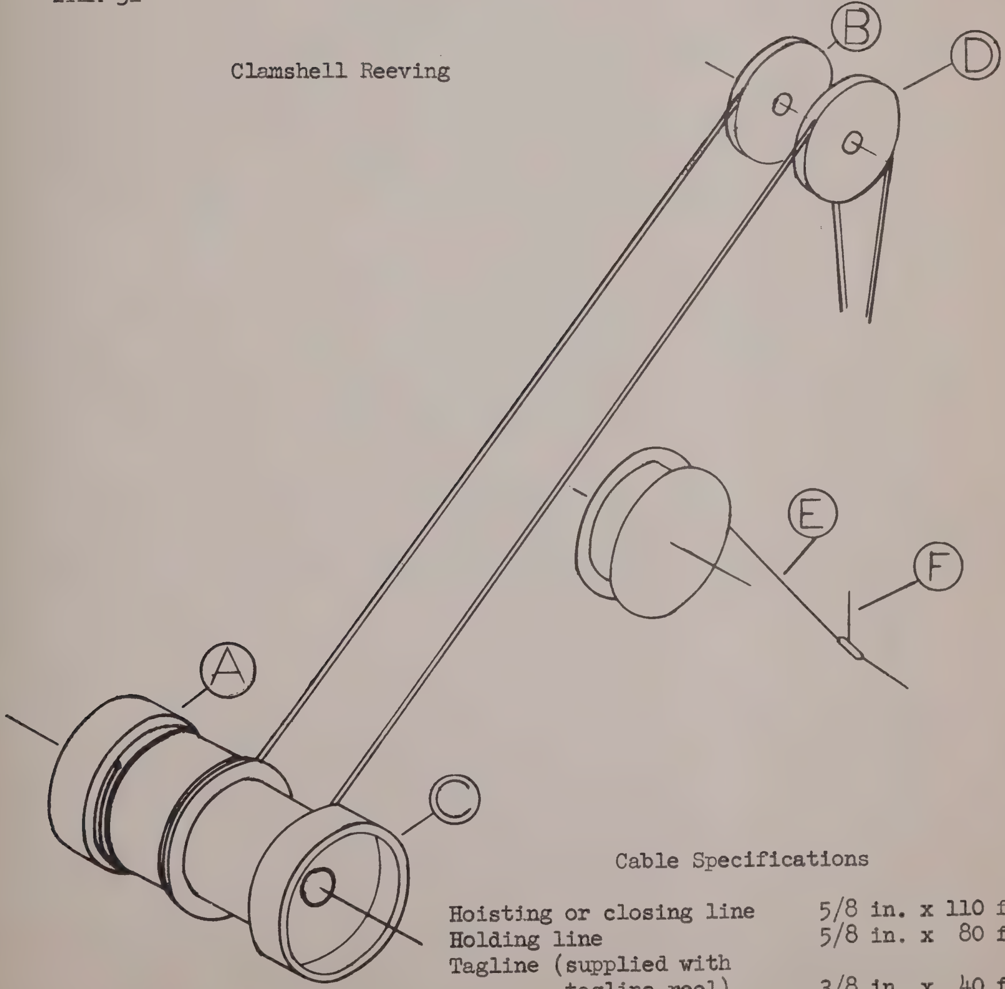
ITEM 30

DRAGLINE OPERATION

The dragline is a piece of equipment requiring a rather precise sense of timing and control to utilize its full efficiency. Draglines are used for a variety of services. The most common use is digging material from a depth somewhat below the level on which the machine stands, depth depending upon the specific job at hand and upon the skill of the operator. While the material handled is sometimes loaded into hauling equipment and moved away, the machines are more commonly used to dig and simply cast the material into spoil banks or along channels. It is necessary to attach the fairlead to the front of the revolving base. The boom is the same as employed for clamshell or crane.

ITEM 31

Clamshell Reeving



Cable Specifications

Hoisting or closing line	5/8 in. x 110 ft.
Holding line	5/8 in. x 80 ft.
Tagline (supplied with tagline reel)	3/8 in. x 40 ft.

ITEM 31 HOW TO REEVE CLAMSHELL ROPES

The hoisting and closing rope is dead-ended to the right-hand drum (C). The other end of the line is led up and over the right hand boom point sheave (B), down through the rope guard and reeved in the clamshell bucket as may be required, depending upon the kind of bucket used. There are usually several parts of line in the bucket for the closing operation, but for more rapid operation in very loose material, one of these wraps may be eliminated. The holding and lowering line is dead-ended to the left-hand drum (A). It is then led up and over the left-hand boom point sheave (B), and finally dead-ended at the top of the bucket head. The tagline cable (E) is attached to the bridle (F), which is in turn attached to the clamshell bucket.

ITEM 32 CLAMSHELL OPERATION

The clamshell is a specialized tool used to excavate pits in confined quarters for culverts, footings and concrete forms. It is extensively used to rehandle material from stock piles or cars into hauling equipment, hoppers or batching bins. It employs the same machinery used in dragline and crane work, except that the bucket is different and the tagline reel is necessary on the boom instead of the fairlead. The clamshell bucket opens and closes, loading itself by literally biting from the material as it closes.

Two ropes are required to operate the bucket. One is called the holding line, the other the closing line. The holding line is reeled on the right-hand drum, and the closing line is reeled on the left-hand drum. This may be changed to suit operator. The same boom is employed as for dragline or crane, and the tagline reel must be attached. The cable from the tagline reel is attached to the bucket to keep it from spinning or turning and entwining the two operating ropes.

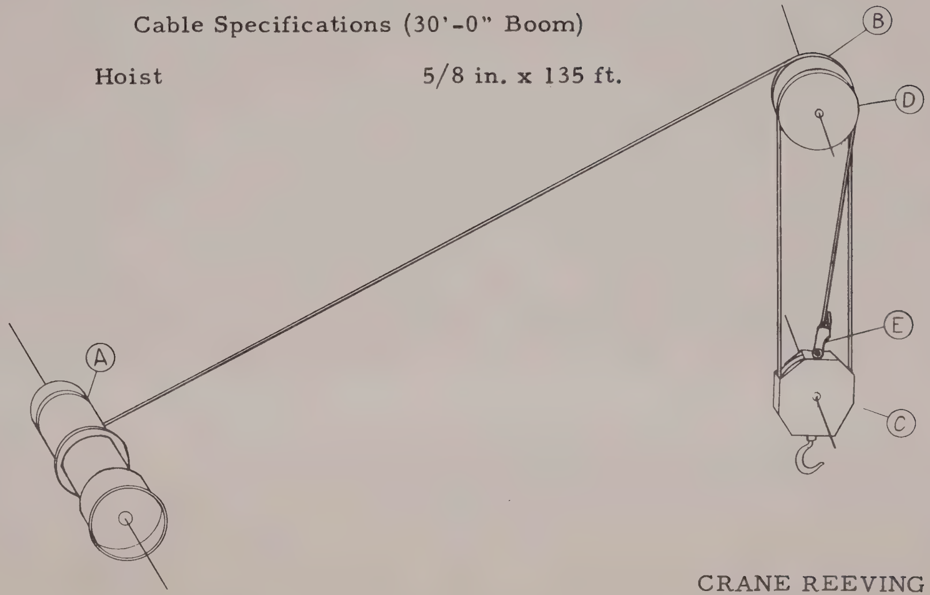
The tagline reel is clamped to brackets provided on the boom. Proper tension on the cable is obtained by turning or winding up the drum counter clockwise. The exact amount of tension is left to the discretion of the operator, but it should be approximately 4 to 5 turns from neutral. Care should be taken not to overwind the spring. Keep barrel of tagline half full of oil.

ITEM 33-A How To Reeve Crane Ropes For a Three-Part Line

The hoist line is dead-ended to the left-hand drum (A), thence over point sheave (B), thence through hook block (C), back up and over point sheave (D), down and dead-ended at point (E).

Cable Specifications (30'-0" Boom)

Hoist	5/8 in. x 135 ft.



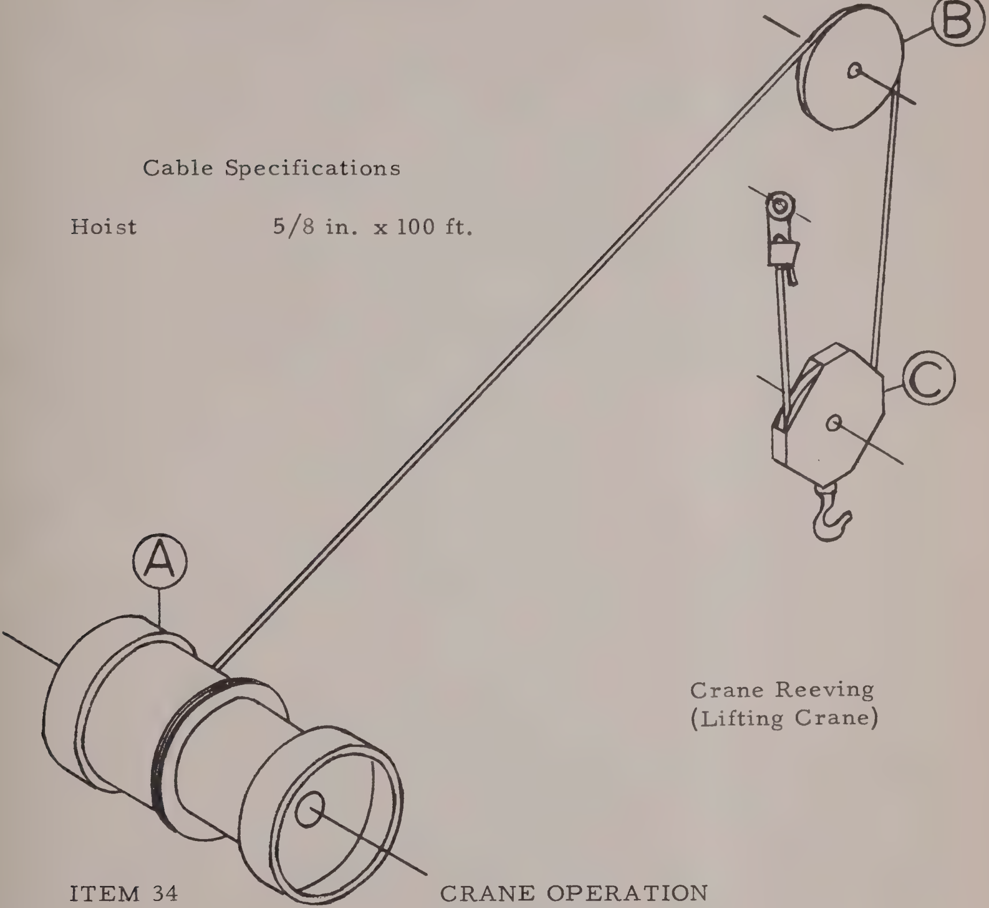
CRANE REEVING
(Lifting Crane)

ITEM 33 HOW TO REEVE CRANE ROPE

The hoist line is dead-ended to the left-hand drum (A), thence over point sheave (B), thence through hook block (C), and dead-ended to the boom shaft by rope socket (D), as shown. The line may be either single or double part as shown. It is possible to reeve two lines for the crane if two separate operations are necessary.

Cable Specifications

Hoist	5/8 in. x 100 ft.



Crane Reeving
(Lifting Crane)

ITEM 34 CRANE OPERATION

The machine equipped for crane service is very simple. It is best to become familiar with the lifting capacities of the machine before attempting heavy lifts as it is possible, due to the great power delivered from the engine, to tip the machine over. Quite naturally, the machine will lift greater loads as the boom approaches the vertical position. Care should be taken in heavy lifts that the load is not lifted any higher than absolutely necessary. When lowering a heavy load, slip the brake slowly. Do not drop the load rapidly and then attempt to catch it by suddenly applying the brake. For heavy lifts at short radius, boom snubbing rods are provided as a safety measure in case of load slippage. To adjust the boom snubbers, set the boom for a load at 10-ft. radius and tighten the nuts against the spring or tighten cables.

ITEM 35

ENGINE

Your engine will give you long and trouble-free performance if you follow these simple instructions:

1. Change oil in crankcase every 50 hours-oftner under extremely dusty conditions.

   Consult your engine manual for proper grades of oil.

2. Change oil filter element every 100 hours or oftner under extremely dusty conditions.

3. Change oil and clean carburetor air cleaner and clean oil filter pipe cup every 50 hours or oftener under extremely dusty conditions.
   Use SAE #20 oil.

4. Oil fan hub every 200 hours.
   Use #90 gear oil.

5. Oil generator every 50 hours.
   Use SAE #20 oil.

6. Grease clutch release shaft 2 points every 50 hours.

7. Keep fan bearing housing filled with oil.

8. Use clean water only in radiator.

9. OIL GOVERNOR DAILY (Not necessary if governor is self oiling)

NOTE: See manufacturer's engine manual furnished with machine for any adjustments.

ITEM 36

TOOLS

Necessary tools for making all adjustments and ordinary repairs are enclosed in the steel box on the machine. The tools should always be replaced in the box after using so that they will be available whenever they are needed.

ITEM 37

LUBRICATION

IMPORTANT: The proper lubrication of the machine is of utmost importance and regular systematic attention should be devoted to this phase of its maintenance. All of the lubricator fittings are accessible and their locations and functions should be learned so that a working knowledge of the

machinery is constantly in mind. LUBRICATOR FITTINGS WILL BE BROKEN OFF OR LOST FROM TIME TO TIME IN NORMAL OPERATION AND SHOULD BE REPLACED AT ONCE.

ANTI-FRICTION BEARINGS: It is not necessary to grease anti-friction bearings as liberally as other bearings. Too much grease has a tendency to heat the bearings and, once hot, the lubricant is soon dissipated. Whenever repair work exposes or requires the removal of an anti-friction bearing, it should be washed with dry cleaning solvent; also wash the housing to remove dirt and grit.

BRONZE BUSHINGS: All other bearings in the machine are of the finest type bearing bronze and will give exceptionally long service if properly lubricated. The operator will need to exercise his own judgment in lubricating the various bearings. The many services the machine performs are different and in some cases one part of the machinery will be used a great deal more than another. Naturally, the heavily used part will require more lubrication than the idle part. Generally speaking, a bearing is properly lubricated when grease is forced from between the bearing and the shaft while being lubricated. Do not allow a great quantity of grease to be forced out as this is not only unnecessary waste, but will drop to the deck of the machine or be thrown into the clutches and brakes. It is always easier to maintain a clean machine. Excess oil and grease should be removed from the machine as it falls; never allow it to collect.

Never allow a bearing or bushing to go without proper lubrication for a period of time longer than recommended by the lubrication chart. Once a bushing begins to cut, it will grind itself out in a very short time. A constant check should be kept of all bushings and bearings in the machine and, as they wear sufficiently to allow considerable lash or play, they should be removed and replaced with new ones. UNDER NO CIRCUMSTANCES ALLOW A BUSHING TO WEAR THROUGH SO THAT THE SHAFT TOUCHES THE METAL SUPPORTING THE BEARING. A very short period of operation under this circumstance will ruin the shaft and may damage the bearing support beyond repair.

OIL SEALS: If it is necessary to remove any of the oil seals in the machine, coat them with Permatex on the outside before replacing. Use a good grade of cup grease or solidified oil. The best lubricant available is the most economical in long range operation. Do not use Permatex on Neoprene Seals. Rubber cement should be used in the installation of this type seal.

LUBRICATION CHART: The lubrication chart should be followed. It was designed to assist the operator in lubricating every fitting at proper intervals. Again the operator's judgment will guide him in lubricating bearings in sustained operation. Never allow a bearing to overheat without sufficient lubrication.

NOTES ON THE LUBRICATION AND SERVICE INSTRUCTIONS IN ADDITION TO THE LUBRICATION CHART

1. FITTINGS: Clean before applying the lubricant gun.
2. AIR CLEANER: Check the level, clean and refill oil

cup every 8 hours of operation. Once a week disassemble air cleaner and wash filter element. CAUTION: Do not use gasoline.

3. CRANKCASE: Check and fill to the level every 8 hours of operation. Drain only when engine is thoroughly warm. Refill to FULL mark on gauge. CAUTION: When running engine, be sure pressure gauge indicates oil is circulating. Change oil every 50 hours, or approximately seven days operation.

4. GEAR CASES: Check level once each week of operation with machine on level ground. Add oil, if necessary. Drain and refill as indicated at points on lubrication chart.

5. FUEL FILTER: Remove and wash glass sediment bowl and screens once each week of operation. Check condition of gasket and renew, if necessary, before replacing bowl.

6. BATTERY: Check level of water in battery weekly. Add distilled water to level of 3/8 inch above top of separators. Clean terminals, tighten snugly, clean and coat lightly with general-purpose grease.

7. OIL CAN POINTS: Lubricate lever shafts, exposed springs, throttle connections, clutch band toggle arms, anchor pins, brake linkage, clevises and bellcranks with crankcase oil once each week of operation.

8. ROLLER PATH AND HOOK UNDER ROLLERS: Keep surfaces clean from oil and grease.

9. ROLLER PATH GEAR AND PINION: Coat teeth every 8 hours of operation.

10. SHOVEL ATTACHMENT: Lubricate point sheaves, boom cable sheaves and dipper padlock sheave once each day of operation. Coat surfaces of dipper handle, saddle block and racking every 8 hours of operation.

11. TRENCH HOE ATTACHMENT: Lubricate all sheaves every 8 hours of operation; also, boom heel and bucket arm bearings.

12. CRANE BOOM ATTACHMENT: Lubricate boom point sheaves, boom hoist sheaves and hook block sheaves every 8 hours of operation. Hook block has oilless type bushing.

13. DRAGLINE ATTACHMENT: Lubricate fairlead swivel shafts and sheaves; also, boom point sheaves and boom hoist sheaves every 8 hours of operation.

14. CLAMSHELL ATTACHMENT: Lubricate tagline reel bearings, boom point sheaves and boom hoist sheaves every 8 hours of operation.

15. CABLES: Keep all cables and wire rope well lubricated, except those coming in constant contact with dirt.

LUBRICATION CHART: Study the lubrication chart carefully and, together with the above instructions, learn to keep all points well lubricated.

ITEM 38

DAILY MAINTENANCE CHECK FOR WAYNE CRANES

MONDAY MORNING:

1. Check crankcase level.
2. Check radiator.
3. Grease padlock sheave.
4. Oil governor sheave. (If not gear driven)

MONDAY NOON:

5. Clean machine of excessive grease or oil.
6. Grease all daily fittings as shown on lubrication chart.

TUESDAY MORNING:

1. Check crankcase level.
2. Check radiator.
3. Oil governor. (If not self oiling)

TUESDAY NOON:

4. Clean machine of excessive grease or oil.

TUESDAY NIGHT:

5. Grease all daily fittings as shown on lubrication chart.
6. Check clutches and brakes for bad adjustment.
7. Check hook roller cap screws for looseness.

WEDNESDAY MORNING:

1. Check radiator.
2. Check crankcase level.
3. Oil governor. (If not self oiling)

WEDNESDAY NOON:

4. Clean machine of excessive grease or oil.

WEDNESDAY NIGHT:

5. Daily grease fittings as shown on chart.
6. Bi-weekly grease fittings as shown on chart.
7. Check all housings for oil levels.
8. Check for loose nuts and cap screws.
9. Oil all levers and brake rods; these are not shown in chart.

ITEM 38 - DAILY MAINTENANCE CHECK FOR WAYNE CRANES

THURSDAY MORNING:

1. Check radiator.
2. Check crankcase.
3. Oil governor.

THURSDAY NOON:

4. Clean machine of excessive grease or oil.

THURSDAY NIGHT:

5. All daily grease fittings.
6. All weekly grease fittings.
7. On shovel - grease shipper shaft, rack and pinion.
8. Change crankcase oil.
9. Change oil filter.
10. Clean carburetor air cleaner and fill with fresh oil.
11. Clean oil breather.
12. Grease boom point fittings and padlock sheave.

FRIDAY MORNING:

1. Check radiator.
2. Check crankcase.
3. Oil governor.

FRIDAY NOON:

4. Clean machine of excessive grease or oil.

FRIDAY NIGHT:

5. Daily grease fittings.
6. Bi-weekly grease fittings.
7. Check dipper stick for looseness.

FIRST FRIDAY OF EVERY MONTH:

1. Grease monthly fittings.

EVERY SIXTH FRIDAY:

1. Check in office for new bulletins and read same.
2. Wipe up any excess oil that has accumulated during week.
3. Check machine for loose bolts and nuts and lost cotter keys.

IN ADDITION:

1. Require reading of care and operation manual.
2. Once per year remove radiator and flush and check for leaks.
3. Remove carburetor and clean and check.
4. Once per month oil generator.

LUBRICANT	CAPACITY	EXPECTED TEMPERATURE			INTERVALS
OE - Oil, Engine		Above +32° F	+32° F To -10° F	Below -10° F	
Engine Crankcase	8 Qts.	SAE 30	SAE 10		
Air Cleaner		SAE 30	SAE 10		
Other Points		SAE 30	SAE 10		D-Daily
Hydraulic Pump	16 Qts.	SAE 10 100% Pennsylvania	SAE 10 +10% Kerosene	SAE 10 +25% Kerosene	
					W-Weekly
GO - Lubricant, Gear, Universal					
Right Angle Gearbox	3 Qts.	SAE 140	SAE 90		M-Monthly
Worm Gearbox	4 Qts.	SAE 140	SAE 90		
Right Angle P.T.O.	3 Qts.	SAE 140	SAE 90		S-Semiannually
CG - Grease, General Purpose		Marfak #2 or Equiv.			
CW - Lubricant, Exposed Gears		Crater Compound			
WP - Grease, Water Pump					

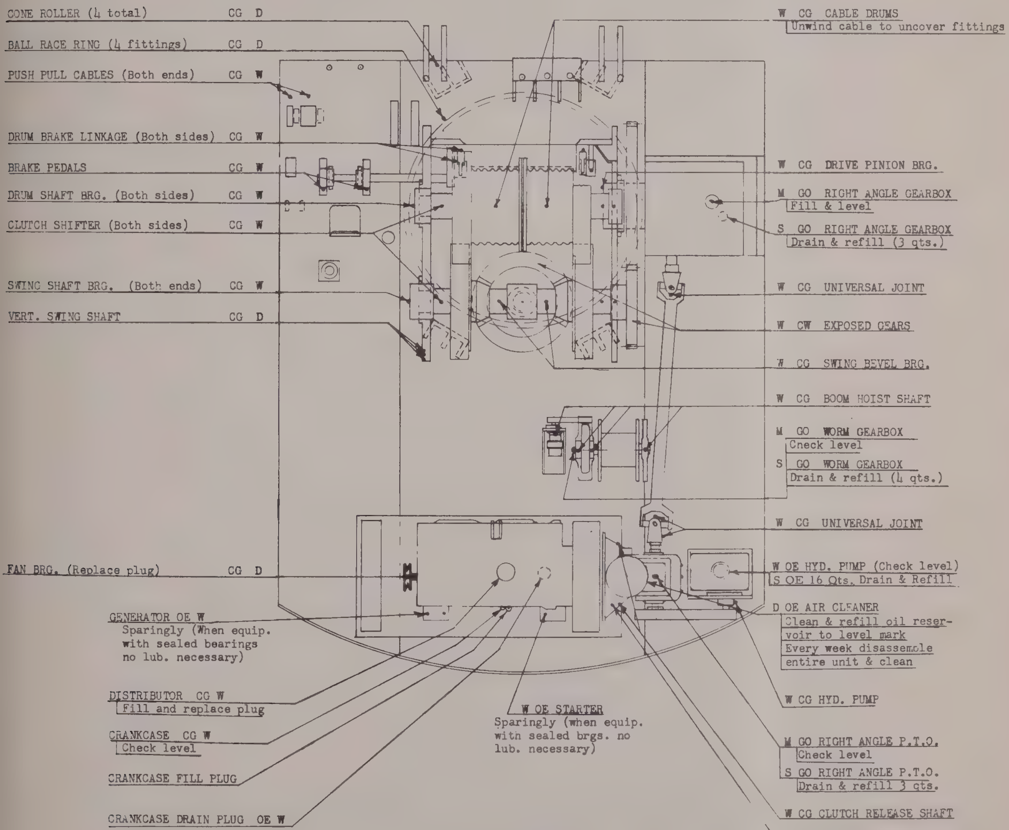
Intervals given are maximums for normal 8-hr. day operation.

For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating.

Clean parts with solvent, or diesel fuel. Dry before lubricating.

Drain crank & gear cases only when hot after operation; check level & replenish when cool.


CONE ROLLER (4 total) CG D
BALL RACE RING (4 fittings) CG D
PUSH PULL CABLES (Both ends) CG W
DRUM BRAKE LINKAGE (Both sides) CG W
BRAKE PEDALS CG W
DRUM SHAFT BRG. (Both sides) CG W
CLUTCH SHIFTER (Both sides) CG W
SWING SHAFT BRG. (Both ends) CG W
VERT. SWING SHAFT CG D
FAN BRG. (Replace plug) CG D
GENERATOR OE W Sparingly (When equip. with sealed bearings no lub. necessary)
DISTRIBUTOR CG W Fill and replace plug
CRANKCASE CG W Check level
CRANKCASE FILL PLUG
CRANKCASE DRAIN PLUG OE W
W OE STARTER Sparingly (when equip. with sealed brgs. no lub. necessary)
W CG CABLE DRUMS Unwind cable to uncover fittings
W CG DRIVE PINION BRG.
M GO RIGHT ANGLE GEARBOX Fill & level
S GO RIGHT ANGLE GEARBOX Drain & refill (3 qts.)
W CG UNIVERSAL JOINT
W CW EXPOSED GEARS
W CG SWING BEVEL BRG.
W CG BOOM HOIST SHAFT
M GO WORM GEARBOX Check level
S GO WORM GEARBOX Drain & refill (4 qts.)
W CG UNIVERSAL JOINT
W OE HYD. PUMP (Check level)
S OE 16 Qts. Drain & Refill
D OE AIR CLEANER Clean & refill oil reservoir to level mark Every week disassemble entire unit & clean
W CG HYD. PUMP
M GO RIGHT ANGLE P.T.O. Check level
S GO RIGHT ANGLE P.T.O. Drain & refill 3 qts.
W CG CLUTCH RELEASE SHAFT
D CG CLUTCH THROWOUT COLLAR

OIL CAN POINTS OE W
Every week, lubricate drum & swing clutch linkages, rods, pins, clevises and threads, exposed spings, throttle, carburetor, governor connections, adjusting screws & outrigger screws with OE.

OPERATOR'S MANUAL

CONTINENTAL MOTORS
AMERICA'S STANDARD

"L" HEAD

ENGINES and POWER UNITS

4 cylinder

6 cylinder

Continental Motors Corporation

Factories: Detroit and Muskegon ··· Offices: Muskegon, Michigan

Printed in U.S.A. HMX6132

"L" HEAD MODELS

Model	Cyl.	Bore	Stroke	Displ.
N-50	4	2⅛	3½	50
62	4	2⅜	3½	62
Y- 69	4	2½	3½	69
91	4	2⅞	3½	91
112	4	3 3/16	3½	112
Y-4069	4	2½	3½	69
4091	4	2⅞	3½	91
4112	4	3 3/16	3½	112
F-124	4	3	4⅜	124
140	4	3 3/16	4⅜	140
162	4	3 7/16	4⅜	162
F-4124	4	3	4⅜	124
4140	4	3 3/16	4⅜	140
4162	4	3 7/16	4⅜	162
F-186	6	3	4⅜	186
209	6	3 3/16	4⅜	209
226	6	3 5/16	4⅜	226
F-6186	6	3	4⅜	186
6209	6	3 3/16	4⅜	209
6226	6	3 5/16	4⅜	226
M-271	6	3⅝	4⅜	271
290	6	3¾	4⅜	190
330	6	4	4⅜	330
M-6271	6	3⅝	4⅜	271
6290	6	3¾	4⅜	290
6330	6	4	4⅜	330
B-371	6	4⅛	4⅝	371
427	6	4 5/16	4⅞	427
B-6371	6	4⅛	4⅝	371
6427	6	4 5/16	4⅞	427

WHEN ORDERING SPARE PARTS BE SURE TO SPECIFY THE FOL- WING INFORMATION WHICH CAN BE FOUND ON THE ENGINE AMEPLATE ON THE SIDE OPPOSITE THE MANIFOLD:

ENGINE MODEL
ENGINE SERIAL NUMBER
SPECIFICATION NUMBER—When indicated

Your cooperation in giving the above data will be of material assistance in ling your orders promptly and correctly.

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FOREWORD

The CONTINENTAL Engine is produced by one of the largest manufacturers internal combustion engines in the world. All Engines are thoroughly tested ore leaving the Continental factory. Notwithstanding this, some attention is uired on your part. To simply fill the gasoline tank, radiator and replenish oil supply is not enough, if you are to obtain the fullest measure of satisfac- n from its performance. The amount of attention required is small, but IM- RTANT.

When, through wear or accident, new parts are required, make certain that ly those of GENUINE CONTINENTAL manufacture are used. Unauthorized alers in spare parts now exist in large numbers but their product in no way asures up to the standard in material and workmanship established by Conti- ntal.

In this book you are given all information required to operate your engine ccessfully. Extensive repairs or rebuilding should be undertaken only by a chanic fully capable of doing such work.

INSTRUCTIONS

Operating Details

Certain distinct steps must be taken to prepare a Continental Engine for rvice. By following these closely the operator will obtain best results.

. Inspect bolts holding down the Engine to make certain that they are firmly t.
. Open Carburetor Feed Valve by turning handle from right to left (counter- ockwise) as far as it will go.
. Close Water Drain Cock in lower Radiator Connection on side of block.
. Examine Oil Drain Plug to make sure that it is tightly closed.
. Fill Oil Reservoir through Filler located on side of Crankcase to "full" vel as marked on Bayonet Gauge located on filler side, in center of Block. Be re that the container used for filling is absolutely clean and free from grit.
. Fill Radiator with clean water.
. Fill Gasoline Tank. Be sure that the container used for filling the Tank is solutely CLEAN and free from dirt. Replace Cap securely.
. Open Throttle Control slightly.
. Turn Ignition Switch to "on" position.
. Pull out Choke.
. Where Clutch is used, same must be disengaged to relieve the operator of necessary effort and permit the engine to get up speed before applying load.
. Push starter engaging mechanism until motor starts.
. Immediately after starting engine, push Choke Button in. Should the engine op after pushing back the choke button, it indicates that the engine is not arm enough to operate on normal adjustment. After starting engine as before, ish choke button part way in. The manipulation of the choke is dependent tirely upon the temperature of the engine. The colder the engine the more oking will be necessary. A warm engine requires little or no choking. NEVER UN AFTER WARMING PERIOD WITH CHOKE BUTTON PULLED OUT. hen starting engine, permit it to warm up before applying load. This especially true during cold weather and where the engine is operating in the open. Another ecaution during extremely cold weather is to partially cover the radiator.

AUTION:

. The first time the engine is started, run it at idle for 5 minutes, no longer, en stop engine and recheck oil level in crankcase. (Do not check oil level while gine is running.) Oil level may be found low due to the fact that considerable l is required to fill the oil passages. Or it may be found high if dip stick was ot removed for venting air during the initial filling. Bring oil level to high mark dip stick.

. It will be found that in service the Engine will, or will not require throttling, epending upon whether the speed desired comes below or equals that for which e Governor has been set. Where extended periods occur between the applications load it is recommended that engine be throttled down to minimum idling speed or, if the intervals are unusually long, that it be shut down entirely. 16. Engines are provided with a Mechanical Governor set to maintain l and speed specified when engine was ordered. It may be necessary to re Governor to meet requirements of the individual installations. The details of Governor and its resetting when necessary are outlined under "Governor Adju ment."

LUBRICATION RECOMMENDATIONS

General: Engine design, the service it performs and the prevailing atm pheric temperatures in which it operates, are factors which determine the b and character of the lubricating oil required to assure maximum performa with minimum costs for supplies, adjustments, repairs and replacements. Th engines which are used in both motor vehicles and for industrial purposes compass a wide field of operating conditions hence, the lubricating oil recomme ations set forth herein are established to meet the requirements of the seve classifications and types of service, seasonal operating conditions considerec

Engine Service: The kind of engine service to be performed influences type of oil best suited for your particular operation. Therefore, before repl ishing or refilling the crankcase reservoir determine from the following expla tion the type and grade of oil to be used, servicing practices considered.

Types of Lubricating Oils: As a progressive move for the benefit of all c cerned the American Petroleum Institute recently formulated commercial expr sions to classify the types of oil as concerns general chemistry composition o namely:

Regular Grade: These are straight mineral oils without additives and are suita for service where engine loads and oil temperatures are moderate and wh crankcase oil change periods are regular and frequent.

Premium Grade: These are straight mineral oils of the higher quality type wh contain Stabilizing Inhibitors that retard oil oxidation as well as bearing corrosi They are preferred in engine service where engine loads are often severe, wh oil temperatures are reasonably high and where crankcase oil change perioc regular but less frequent.

Heavy Duty Grade: These are very high grade mineral oils to which have b added Stabilizing Inhibitors which further retard oil oxidation also hard al engine bearing corrosion and to which have also been added Dispersive Deterg compounds which keep the solid contaminates from combustion in a finely divi state whereby they remain in suspension within the engine oil and are remo when the crankcase oil is changed. These oils should be used in all engines p forming Heavy Duty Service where severe loads are accomodated for periods considerable time even though crankcase oil changes are regular and freque

Oil Character: This is identified in several ways familiar to the petrole chemist. The yardstick most familiar to those operating engines is that of V cosity Index. This is a measure of the amount of the oil body changes with cha in temperature; ratings are established from 0 to 100; the higher the rating better is the oil for automotive engine service. High Viscosity Index oils do thicken up so much at low temperature thereby assuring easier cold starting a prompt oil circulation; neither do they thin out so much at the higher operat temperatures, which characteristic contributes to longer engine life and lo oil consumption.

Oil Body: This is Laboratory measured in Seconds/Viscosity/Temperature; heavier the oil, the greater its Seconds Number. The yardstick most famil to those who operate engines is the Society of Automotive Engineers Grad System expressed in SAE Numbers. As concerns engine oils these range as 1 20W-30-40-50-60-70; the most popular grades used in the Automotive Eng services are the first four mentioned; the lighter bodied oils are used chie during the colder seasons of year.

Grade Recommendations: See chart on Page 20.

lity Oils: The use of high Grade, high Viscosity Index Oils (Minimum such as Socony-Vacuum Oil Company Mobiloils and Delvac 900 Series oils are mmended. Socony-Vacuum's several oils conforming to the types and grades ulated herein are as follows:

Premium Grade: Mobiloil AF (SAE 40); Mobiloil A (SAE 30);
Mobiloil Arctic (SAE 20W); Mobiloil Arctic Special (SAE 10W).
Heavy Duty Grade: Delvac 940 (SAE 40); Delvac 930 (SAE 30);
Delvac 920 (SAE 20W); Delvac 910 (SAE 10W).

Engines—Reconditioned Engines: The crankshaft to bearing clearances those clearances between pistons, piston rings and cylinders (also other ing component parts) are very small in new engines and in engines which e been reconditioned with new and newly machined parts. To assure adequate distribution to these closely fit surfaces during the first week or 50 hours ngine operation, the use of a light bodied oil is desirable. When this engine -in is performed during the warmer months of the year an SAE 10W or SAE should be used.

Change Frequency: Good oil; oil of the proper body and character for service being performed; oil kept free from the several forms of contamina-, assures minimum engine wear and replacement of parts. The frequency with ch the oil should be changed is contingent upon (1) the quality of the oil g used (2) the severity of engine operation (3) the mechanical condition of engine (4) the rate and kind of contamination from engine operation or the rounding elements and circumstances. Generally speaking, good average ining frequencies are: Industrial Engines every 50 hours of operation; Motor icles from 1500 to 2000 miles of operations.

UTION: Do not overfill the crankcase. An excess of oil does not improve ication. It causes high oil consumption, smoking and carbon deposit. Fill to proper level, never letting it come below the "low" mark on the bayonet gauge.

DO NOT FLUSH CRANKCASE WITH KEROSENE

The reason for this is that some of the kerosene may be trapped and will ain to thin out the new oil, reducing its lubricating qualities. Some operators visely put kerosene in the crankcase after draining out the engine oil, then the engine over with the starter in the belief they are doing a better job rankcase cleaning. In doing this, kerosene is circulated through the oil pump, main oil header and its branch leads into the engine bearings thereby washing y the protective oil film. Do **not** put kerosene into the crankcase. The best hod is to drain the oil when the engine is thoroughly heated. This will carry most of the sediment.

Bath Air Cleaners—Oil Filters: These devices contribute materially to engine parts wear and to lowered engine oil contamination; they progressively uce or remove contamination by solids which otherwise would reach the metal bing surfaces of the engine interior. As these devices remove the dirt from incoming air or solids liberated by fuel combustion, they progressively become effective with use in their power to clean. The Air Cleaners should be fre-ntly cleaned and their reservoir oil renewed also the oil filter elements should renewed from time to time, as dictated by the service conditions under which y operate.

ling Fan Bearing: This is of the anti-friction type bearing. Those pumps ing a low pressure fitting are lubricated by hand gun using a heat resisting, rt fibre grease of No. 2 NLGI consistency such as Socony-Vacuum's Mobil-ase No. 5. The water pump is mounted integral with the Cooling Fan Shaft. pump seal is water lubricated from the engine cooling system.

essories: The oil cups attached to the Ignition Distributor, Electric Gen-tor and Starting Motor should receive a few drops of engine oil each 100 hours operation.

Compressors: Where Air Compressors are in use and where they are ricated separately from the engine system, the same type and grade of oil used in the engine may be used in the compressor crankcase reservoir.

OIL PRESSURE

(See Chart on Page 21)

POWER TAKE-OFF

When Power Take-Off is used it should be lubricated through the Zerk Fi provided for that purpose following the instructions on the plate attached t unit.

Where clutch is used follow the direction on manufacturer's plate att to unit. Where, in insolated cases, this plate is omitted, the following shou observed.

IMPORTANT: If clutch does not pull, heats, or operating lever jumps the clutch must be adjusted.

ADJUSTMENT: Remove hand hole plate, turn clutch until adjusting pin can be reached. Pull adjusting pin out and turn adjusting yoke to rig clockwise, until operating lever requires a distinct pressure to engage. A clutch requires several adjustments until friction discs are worn in.

LUBRICATION: Lubricate clutch throw-out collar and ball bearings o day before starting.

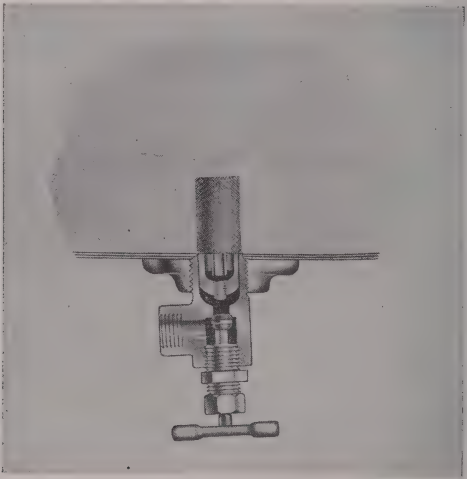


Figure 1

Combination Gasoline Shut Off Valve and Edge Type Filter

This semi-permanent unit, assembled in all overhead mounted gas t filters out all foreign particles and prevents any water that may get into from entering the carburetor.

Using reasonable care in filling tank, with emphasis on CLEAN C TAINERS, the filter should not require any attention whatsoever. If the e ever requires an overhaul job, however, it is an excellent idea to have the tank and filter cleaned at the same time.

COOLING

If the water is permitted to drain or evaporate down to an insufficient ount, serious over-heating will take place. Moderately soft water is most irable; if not obtainable we recommend that the system be drained every two ks and flushed with clear running water.

Never use kerosene for cooling purposes in place of water, as its vapor is hly inflammable, increasing the fire risk to a prohibitive extent.

In cold weather, a suitable anti-freeze should be used. ANTI-FREEZE solu- is come in 3 general types and may be used in the following proportions by ime to withstand the temperatures indicated: for example, 1 qt. of Alcohol to ts. of water for 10° F.

	32° to 10°F	+10° to -10°F	-10° to -30°F
AIN ALCOHOL—(evaporates eas- y)—Check with Hydrometer and eplenish often—If spilled on paint vash thoroughly immediately.	1 to 3	4 to 9	5 to 8
THYL ALCOHOL COMPOUNDS -such as Zerone, Norway, etc. evaporates less easily)—Check and eplenish occasionally.	1 to 4	2 to 5	1 to 1
HYLENE GLYCOL—such as Pres- one, Zerex, Peak, and GM (per- nanent type)—When there are no eaks add water **only** to make up or evaporation.	1 to 4	2 to 5	1 to 1

TROUBLE SHOOTING GUIDE

A good rule to follow in locating engine trouble is to never make more than adjustment at a time. Stop and think how the motor operates, and figure out probable cause of any irregular operation. Then locate the trouble by a pro- s of elimination. Remember that the cause usually is a SIMPLE ONE, rather n a mysterious and complicated one. The following outline will be helpful in ting ordinary engine troubles:

ENGINE IS CRANKED AT NORMAL SPEED BUT ENGINE WILL NOT START

(This also covers hard starting and slow starting. Possible causes will be ered under (A) Improper Carburetion, (B) Electrical Difficulties, (C) Poor npression, (D) Wrong timing).

IMPROPER CARBURETION

1. Out of fuel: tank empty?
2. Is fuel reaching the carburetor?
   First disconnect line from fuel tank to carburetor, and see if gasoline flows out freely. This line may be clogged with dirt.
3. Is fuel reaching the cylinders?
   The choke may not be closing tightly. The carburetor may be out of adjustment, float level too low, or the jets may be clogged with dirt or gum.
4. Engine flooded?
   If the spark plugs are wet, this indicates flooding, caused by using the choke too long.
5. Air leaks at intake manifold or governor gaskets.
6. Poor grade fuel in combination with cold weather. In very cold weather, heating the oil will help.

ELECTRICAL DIFFICULTIES

1. Primary Circuit:
   Faulty or shorted ignition switch.
   Corroded, dirty or loose connections.
   Weak, leaky or grounded condenser.
   Magneto points pitted or fused.
   Magneto points set to wrong gap.
   Breaker arm sticking.
   Hinge bushing tight on pin.

2. Secondary Circuit:
   Corroded, dirty or loose connections.
   Pay particular attention to high tension wire from coil to distributor, all wires in distributor cap.
   Wet wires.
   Moisture or carbon on spark plug.
   Cracked insulation, leaks and shorts.
   Cracked distributor cap.
   Carbon contact inside distributor cap broken or missing.
   Rotor contact spring broken.
   Improper gap on spark plugs.
   Fouled or cracked spark plugs.
   Magneto wired to wrong plugs.

C. POOR COMPRESSION

A rough-and-ready check for compression is to remove a spark plug place your thumb over the spark plug hole, then crank the engine. Accu method is to use a compression gauge. Do not expect all cylinders to show same compression pressure, but a decided difference will indicate improp seating valves, worn rings, worn cylinder, or leaky gasket. After taking initial reading, seal the piston with a teaspoonful of engine oil poured thro spark plug hole, and take a second reading; if pressure does not increase this indicate that improperly seating valves are at fault. Poor compression ma caused by any of the following:

1. Loose head.
2. Damaged cylinder head gasket.
3. Poorly seating valves.
4. Broken valve springs.
5. Valves holding open due to insufficient tappet clearance.
6. Valves sticking open due to carbon and gum on stems or in guides.
7. Badly worn, broken or stuck piston rings.
8. Cylinder scored.

D. WRONG TIMING

Remove No. 1 spark plug, put your thumb over the spark plug hole and for compression stroke, cranking the engine over by hand. Then set piston on dead center of the compression stroke. T.D.C. mark on flywheel will line up pointer in bell housing, the breaker points in distributor should be just star to open.

TROUBLE SHOOTING
(Continued)

Lack of Power

1. Faulty compression.
2. Incorrect timing.
3. Poor carburetion.
4. Restriction in air supply to carburetor caused by dirt in flame arre screen, or choke valve not completely opening.
5. Throttle control linked up so that throttle valve is not fully opening.
6. Dirt in sediment bowl of fuel pump.
7. Dirt in fuel lines or carburetor jets.
8. Air leak in fuel pump or fuel line.
9. Air leak in manifold gasket or at governor gaskets.
10. High engine temperature, caused by worn water pump or clogged w jackets.
11. Vent of gasoline tank not open.
12. Pre-ignition, caused by carbon deposits.
13. Engine misalignment.

Rough, Uneven Idling

1. Improper adjustment of carburetor.
    - Idling jet air passage clogged.
2. Air leaks in intake manifold or carburetor.
    - Loose manifold nuts.
    - Damaged gasket at manifold.
3. Faulty ignition.
4. Spark plug difficulties.
5. Uneven compression.
6. Water leak at cylinder head gasket or manifold.

Missing at High Speed

1. Spark plug troubles.
2. Broken insulation on high-tension wires.
3. Faulty breaker-points.
4. Fuel obstruction, indicated by back-firing.
5. Incorrect tappet clearance.

Missing at All Speeds

1. Blown head gasket.
2. Sticking valves, broken valve spring.
3. Fouled spark plug, broken insulation.
4. "Leaky" high tension wiring.
5. Pitted or fused breaker points.
6. Incorrect breaker-point gap.
7. Incorrect valve tappet clearance.
8. Punctured condenser.
9. Gasket leak at intake manifold or governor.

Crankshaft Knocks

These are usually detected as dull, heavy, metallic knocks which increase in
equency as the speed and load on the engine is increased. The most common
ankshaft knock is that caused by excessive clearance at one or more main bear-
gs. This is most audible when engine is pulling hard, on acceleration, or when
gine is cold. By alternately shorting out each spark plug, the approximate
cation of the loose bearing can usually be determined. Excessive crankshaft end
ay causes a sharper noise or rap which occurs at irregular intervals. In bad
ses this can generally be detected by releasing and engaging the clutch. Causes
crankshaft knocks include the following:

1. Excessive bearing clearance.
2. Excessive end play.
3. Eccentric or out-of-round journals.
4. Sprung crankshaft.
5. Insufficient oil supply.
6. Low oil pressure.
7. Badly diluted oil.
8. Loose Flywheel.

Connecting Rod Noises

Connecting rod noises are usually a light pound or knock of much less in-
nsity than main bearing knocks. The noise is usually evident with the engine
ling and becomes louder when engine speed is slightly increased. Connecting
d noise can best be located by shorting out one spark plug at a time. These
ises should not be confused with piston or piston pin noises. Possible causes
e as follows:

1. Excessive bearing clearance on crank pin.
2. Insufficient oil supply.
3. Low oil pressure.

4. Badly diluted oil.
5. Misaligned connecting rods.
6. Out-of-round or tapered crank pin journal.

Piston Noises

The most common piston noise is “slap,” due to the piston rocking from to side in the cylinder. Piston-slap usually causes a hollow, muffled bell sound, or a click. Slight piston noises that occur with a cold engine and disap after the engine is warm, do not warrant replacement. Piston-slap is audible when driving the engine at low speed under load.

Piston and ring noises can be located by putting a spoonful of heavy en oil (S.A.E. 50) into the suspected cylinder through the spark plug hole. C the engine over by hand for several revolutions with the ignition off, until oil has worked down past the piston rings. Replace the spark plug, start engine, and determine if the noise still exists.

Piston Pin Noises

The most common piston pin noise is the result of excessive piston clearance. This is characterized by a sharp, metallic double knock, gene audible with the engine idling. Possible causes:

1. Excessive piston pin clearance in piston boss.
2. Excessive piston pin clearance in bushing.
3. Bushing loose in connecting rod.

Valve and Tappet Noises

Noisy valve action has a characteristic clicking noise occurring usuall regular intervals. The frequency of valve action noise is generally less other engine noises, because the valves are operated by the camshaft runnin one-half of crankshaft speed. If one or two of the valves or tappets are cau the noise, the clicking sound will be intermittent, but if the condition exists a majority of the valves, the noise may be continuous.

The common cause of valve action noise is that of excessive clearance tween tappet and valve stem. Instructions for valve tappet adjustment are ered in detail on page 13. Possible causes of valve and tappet noises:

1. Excessive tappet clearance.
2. Threads stripped on adjusting screw.
3. Broken valve springs.
4. Excessive valve stem to guide clearance.

Spark Knock and Fuel Knock

Included under this heading are Pre-ignition and Detonation. Pre-ign is caused by an incandescent particle of carbon or metal in the combustion ch ber, which fires the mixture prematurely, while the piston is still rising. Det tion is caused by fuel of improper octane value, which burns too rapidly, thro a sudden and abnormally high pressure against the piston. The two ha similar sound, a metallic ringing knock which is often described as a “pi This is usually heard when the engine is accelerated rapidly, or overhe Causes:

1. Carbon deposits in combustion chamber.
2. Ignition timed too early.
3. Faulty spark plugs.
4. Carbon on spark plugs or burned porcelain.
5. Hot valves resulting from:
    Insufficient tappet clearance.
    Improper seating.
6. Excessive engine temperature, caused by faulty water circulation.
7. Low octane fuel.

8. Old or stale fuel.
9. Extremely lean carburetor mixture.

TE: Continental Engines of current manufacture are calibrated to produce rated engine power, maximum smoothness and economy when using gasoline of 75 ASTM, Motor Method, Octane Value. Gasolines of slightly lower or higher Octane Values may be satisfactorly used in these engines by making minor engine adjustments and by changing Ignition Spark Plug timing for the fuel to be used. For specific instructions on these adjustments write Continental Engine Service Department, giving full information on the fuel to be used.

Vibration Originating At Engine

The most common sources of vibration originating in or on the engine, as :inguished from causes originating outside the engine (covered below) are as ows:

1. Misfiring.
2. Misalignment of engine.
3. Bent or off-center coupling.
4. Engine loose on bed.

Uncommon Engine Noises

The following possible causes of engine noise are more rare, but should be sidered and checked in locating foreign sounds:

1. Flywheel loose on crankshaft.
2. Crankshaft pulley loose on flywheel.
3. Loose exhaust pipe at manifold connection.
4. Loose engine accessories, such as generator, water pump, etc.

Backfiring at Carburetor

Engine back-firing through the carburetor when starting cold is many times voidable as it is the result of imperfect air-gasoline mixture, which will auto- tically correct itself after the engine reaches normal operating temperatures. e "reason why" of back-firing in this case is late burning of the mixture in the inder, due to improper ratio of fuel to air, igniting the incoming charge and sing an explosion in the intake manifold and carburetor. Thus lean mixtures l retarded spark are the commonest cause of back-firing. Continued back- ng after the engine is warm should be corrected by checking the following sible causes:

1. Excessively lean fuel-mixture.
2. Late ignition timing.
3. Improperly seating valves, especially intake.
4. Obstruction in fuel line.
5. Dirt or water in sediment bowl.
6. Intake manifold air leaks.
7. Poor grade of fuel.
8. Secondary wires crossed in distributor cap.
9. Faulty spark plugs.

Abnormal Oil Consumption

1. Piston rings stuck, worn or broken.
2. Piston rings improperly fitted.
3. Scored or worn cylinder bore.
4. Out-of-round cylinder bore.
5. Excessive bearing clearances.
6. Excessive oil pressure.
7. Oil level too high.
8. Oil leaks at seals and gaskets.
9. Overheating.

Before deciding that worn piston rings or worn cylinders are the cause of gh oil consumption, don't overlook the possibility of oil leaks. Give attention rticularly to the oil seals. Slow leaks can be located by spreading a paper der the engine.

If plugs foul up persistently, and if the exhaust is smoking, this indic that the engine may be pumping oil, either past the pistons or along the v stems. Another cause of fouled plugs is too high an oil level, causing cranks to dip and splash excessive oil.

Remember that it is normal for an engine to consume and burn a cer amount of oil, the quantity depending on the speed of operation.

Low Oil Pressure

Complete absence of oil pressure is sure sign of a broken oil pump or lac oil. (Normal oil pressures are listed on page 21.) Possible causes of low pressure:

1. Incorrect grade of oil.
2. Badly diluted engine oil.
3. Oil relief valve not properly seating.
   Look for dirt on seat of valve.
4. Clogged oil cooler.
5. Air leak in oil pump suction line.
6. Sludge on oil pick-up screen.
7. Worn or damaged pump gears.
8. Inaccurate oil pressure gauge.

High Oil Pressure

Oil pressure should not exceed recommended pressures on page 21, ex momentarily when the engine is started up cold. Abnormally high oil pres is not desirable because it increases oil consumption. Possible causes of oil pressure:

1. Engine oil too heavy.
2. Relief valve not opening (It may be stuck).
3. Obstruction in distributing line.
4. Inaccurate oil pressure gauge.

Fouled Spark Plugs

1. Worn piston rings.
2. Worn cylinders.
3. Excess piston clearance.
4. Rich mixture.
5. Gap too narrow, causes missing at idle.

Burned Spark Plugs

1. Lean mixture.
2. Late ignition timing.
3. Engine overheated, due to worn water pump, obstructions, etc.
4. Low octane fuel.
5. Badly leaking valves.

Hard Starting

1. Magneto points burned or corroded.
2. Points improperly adjusted.
3. Wrong gap in spark plugs.
4. Spark plug wires loose and corroded in Magneto cap.
5. Loose connections in primary circuit.
6. Defective condenser.
7. Choke not fully closing.

Back Firing

1. Crossed plug wires.
   See "Backfiring at Carburetor" for other causes.

Missing At High Speed—Under Load

1. Incorrect gap in spark plugs.
2. Defective spark plugs.
3. Defective coil.

Pre-Ignition

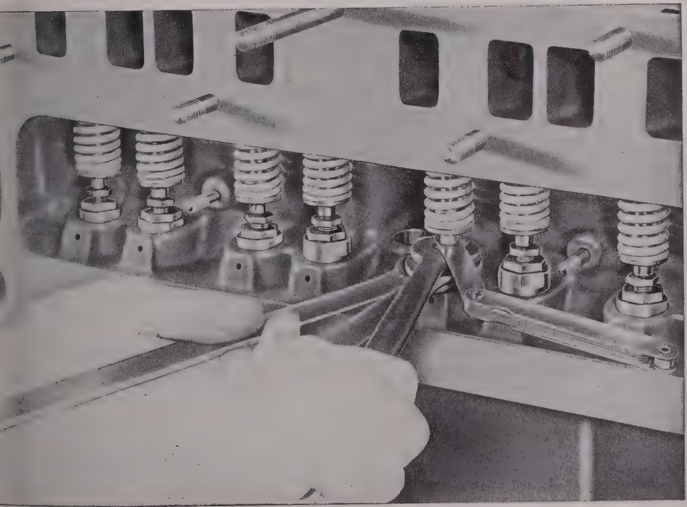
1. Carbon deposits.
2. Overheating.
3. Ignition timing set too early.

ADJUSTING TAPPETS

The correct clearance between the tappet and the valve stem is very im- rtant. This should be set according to the chart on page 20. Three wrenches d a feeler gauge will be required to make the necessary adjustment.

When the adjustment has been correctly made the feeler gauge will pass tween the tappet and valve freely.

It is recommended that the tappets be adjusted with the machine running at e speed whenever possible. If it is not possible to make the adjustment with e engine running, it will be necessary to crank the engine until both valves are sed and the piston is on Top Dead Center on the compression stroke. As a al check start the engine and be sure the correct feeler gauge will pass between e tappets and valves.



ZENITH 62 SERIES CARBURETOR

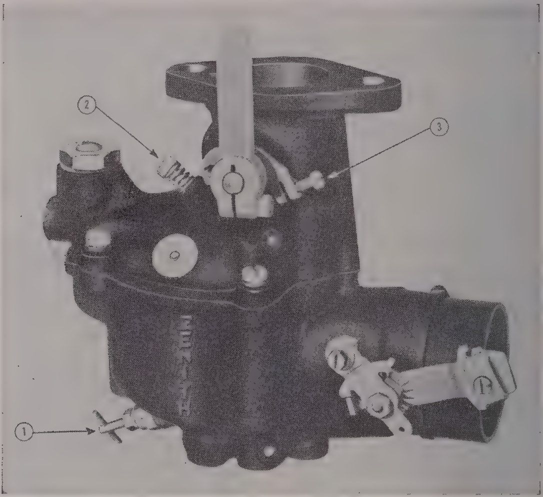


Figure 2

Zenith 62 Series Carburetor

The main adjustment screw (1) determines the amount of fuel which ma
obtained for high speed operations. To set this adjustment, open the throttle to
proximately ¼ open. Turn the adjustment clockwise, shutting off the fuel u
the engine speed decreases or begins to miss due to too lean mixture. Now c
the adjustment until the engine reaches its maximum speed and runs smoo
without missing.

The idle mixture adjustment needle (2) controls the amount of air admi
to the idling system (which functions only at low speeds). Turning the ne
(2) clockwise cuts off air, making the mixture richer while unscrewing it ad
more air making the mixture leaner. The idle adjusting needle should be set
smoothest running of the engine, or, if a vacuum gauge can be attached to
manifold, set the adjustment for highest manifold vacuum. This point will
incide with the smooth running of the engine.

The idle speed adjustment screw (3) controls the required idling speed

Adjustment Instructions For
MODEL TSX MARVEL SCHEBLER CARBURETOR
Without Power Adjustment

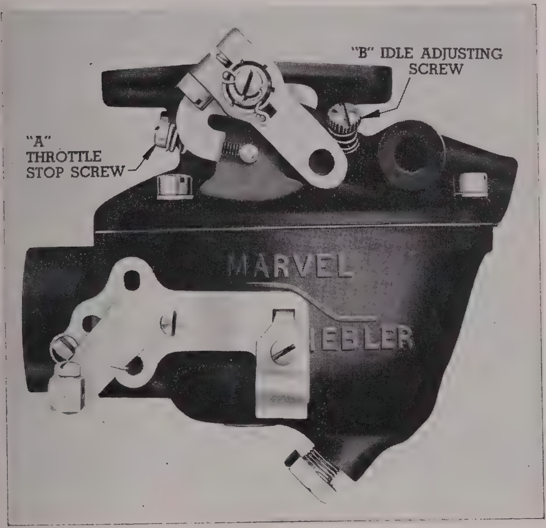


Figure 3

eliminary Carburetor Adjustments

Set throttle stop screw "A" so that throttle disc is open slightly. Make cer-
in that gasoline supply to carburetor is open. Set throttle control lever to one-
ird open position. Close choker fly by means of choke control button. Start
gine and partially release choke. After the engine has been run sufficiently to
ing it up to operating temperature throughout, see that choke is returned to
de open position.

w Speed Adjustment

Set the throttle or governor control lever in slow idle position and adjust
rottle stop screw "A" for the correct engine idle speed. (On a new, stiff
gine this speed must be slightly higher than required for a thoroughly run-in
gine.) Turn idle adjusting screw "B" in, or clockwise, until engine begins to
lter or roll from richness, then turn screw "B" out, or counter-clockwise, until
e engine runs smoothly.

Note: It is better that this adjustment be slightly too rich than too lean.

GOVERNOR
(Centrifugal Flyball Type)

In this type of governor two forces are utilized to gain the regulation des The first is the centrifugal force created by the balls which tends to close throttle as the speed of the engine increases. The second force is that of spring. This force is constant and tends to hold the throttle in wide open pos at all times. When these forces are in equilibrium, the engine is operating a predetermined governor speed.

If load is applied, the engine slows down and decreases the centrifugal of the balls. The spring force, then being the greater, opens the throttle returns the engine to the governed speed.

If the load is thrown off, the engine gains RPM and causes the weight to exceed the spring force. This excess of force closes the throttle and bring engine back to the governed speed.

REPLACEMENT OF PARTS

Check all bearings for roughness of wear. Replace all rough or worn bear

Check the yoke for wear where it contacts the thrust bearing and for s of fracture.

Use new oil seal when reassembling.

If there are worn parts in the assembly consisting of spider shaft, spider, diaphragm, diaphragm bearing or the drive gear, it is necessary to rep the entire assembly. Oil all bearings before reassembling.

OPERATION AND SERVICE OF NOVI GOVERNORS ON CONTINENTAL ENGINES

Novi Governors differ from conventional centrifugal governors princip in that round steel balls are used as the motivating force producer in the N instead of masses of weight.

The balls move "out" and "in" radially from the governor shaft on hardened steel races. One race is a flat surface, the other conical in shape. the balls move "in" and "out" they tend to raise or lower the conical shaped the motion of which is transferred through a fork or finger to the gover lever on the outside of the governor housing.

The force created by the balls in their centrifugal movement on the gover lever is opposed by a spring, one end of which is hooked to the governing le the other end of which is hooked to the speed adjusting screw lever.

To increase engine speed, tension of spring is increased and to lower s the tension is decreased. To increase the spring tension, turn screw "A" ou in a counterclockwise direction after loosening the locknut. Then loosen loc on Screw "B" and turn in or in a clockwise direction. To decrease the sp tension, reverse the above procedure. After making the adjustment, be certai tighten the two locknuts.

Should governor surge at no load speed, screw Bumper Screw "C" in until ge is eliminated. Don't run Bumper Screw in far enough to increase speed.

The slotted driver, in which the balls move is pinned to the governor shaft; two races are free floating on the shaft. When the engine is running at a d speed all parts go around with the governor shaft and the thrust is taken on thrust bearing between conical shaped race and fork base. When a change in ed, due to change in load, takes place, the relative speed between the balls and es is changed. Consequently, wear is distributed over the entire operating face of the races and balls. Since the surfaces are hardened, little or no wear er than a polish should ever take place on these parts.

The driver must always be tight to the shaft. The races must be free on shaft.

In assembly of the governor a space of .004 to .006 is provided between the ver and the flat race. This is to assure freedom for movement of the flat race. en servicing the governor, make sure that both races revolve freely on the ft.

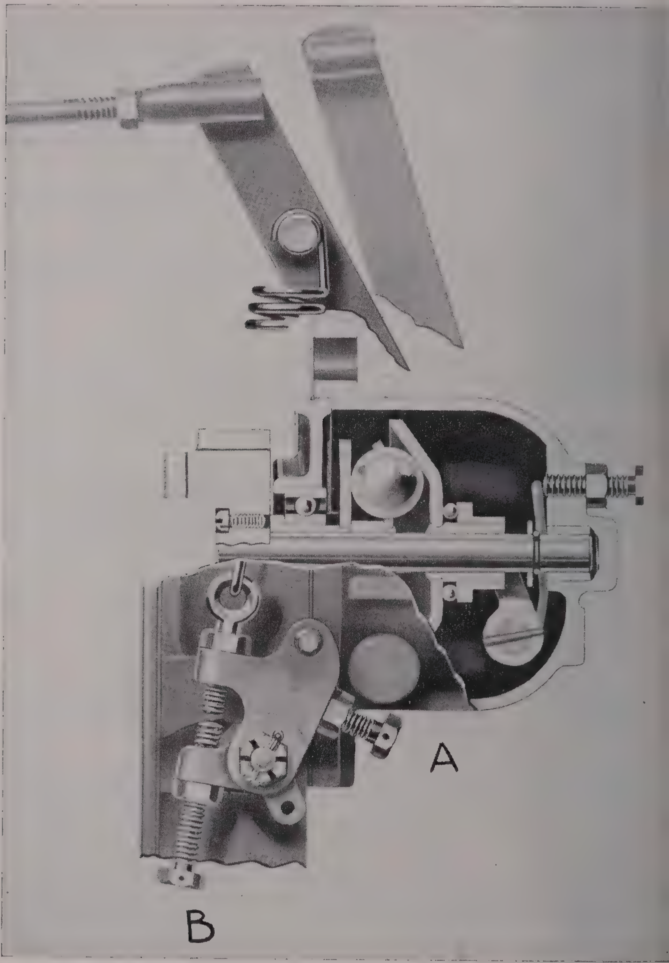
When the balls are "in", that is in the bottom of the driver slots, the space ween the top of the conical shaped race bushing and hair pin clip should be 0-.240. Use .010 spacer washers to obtain required space.

The governor shaft is pressed into gear and secured with screw that is rtially in the shaft and partially in gear.

Lubrication is supplied the governor by splash from the front end gear train ough holes provided in the governor base. Like all mechanical governors, the vi must have ample lubrication for its functioning. Make sure the governor rts are being well supplied with oil.

The hook-up of governor lever to carburetor lever should be done in the fol- ving manner:

1. Make sure carburetor shaft does not stick nor bind.
2. With governor lever in its normal position under spring tension, with engine shut-off, with carburetor lever in wide open throttle position, a rod of exact length to connect the two levers is inserted.
3. Make sure that there is no bind nor sticking in the assembly of rods and levers. **This is very important.**



NOVI GOVERNOR

LOCATING IGNITION TROUBLE

If you suspect ignition trouble when engine does not start (provided the ttery is well charged and starting motor is functioning), or if the engine is nning irregularly, the following routine is a good short method of locating the uble:

. Disconnect the high-tension wires to spark plugs, one cylinder at a time, and ld the end of the wire about ¼″ from the cylinder head, then trip the starter ay switch (use the emergency switch under screw cap at end of solenoid) and serve if you get a good spark. This may also be done by shorting across with a ew-driver, without disconnecting wire to the plug.

. If spark is good then the trouble is in the spark plug, which may be cracked fouled. Remedy: install new plug. Gap should be .025.

. If spark is weak, or missing altogether, check the coil.

. Pull the high tension wire that leads to the coil out of the distributor cap d hold end of wire ¼″ from cylinder head, then test again for spark.

. If you get a weak spark or no spark here, trouble is indicated in the coil or stributor. Examine the high tension wire, also the primary wire leading from stributor to coil.

. The distributor compartment cover should be removed, care being taken not damage the gasket attached to the cover side of the joint. The interior should thoroughly cleaned and the air inlet and outlet passages opened. Examine the gh tension lead brush; replace if noticeably worn or damaged. This brush ould move freely in its holder and should have a slight spring pressure.

. Remove the distributor cap and check the breaker points; these should be amined for evidences of pitting or pyramiding. A small tungsten file or fine one may be used to resurface the points. If points are worn or badly pitted, ey should be replaced. Points are to be adjusted to have a .020 inch gap at full paration. Adjustment is made by loosening the round head locking screw at the pper end of the stationary point bracket, then turning the eccentric head adsting screw until the gap is obtained, and locking the assembly by tightening e round head screw.

. If you do not get a satisfactory spark from the coil after distributor has een checked, trouble is indicated in the coil.

. Check the high tension wires from distributor to spark plugs. These wires ust be dry as surface moisture will cause a short.

DISTRIBUTOR MAINTENANCE

. Check Breaker Arm Hinge: Make sure the breaker arm moves freely on its nge, and apply a drop of light oil as covered under "Lubrication." Moisture or l under certain conditions may cause swelling of the fiber bushing in breaker m hinge, producing irregular running at high speeds. Remedy is to ream the ishing very slightly.

. Adjust breaker points: If the points are burned or pitted they should either e replaced or dressed down with a fine-cut stone or point file. File must be clean nd sharp. Never use emery cloth to clean contact points. After filing, check the reaker point gap and reset to .020. The breaker arm must be resting on the high oint of the cam during this operation.

When replacing contacts be sure they are aligned and that they make contact ear the center. Bend the stationary arm to secure proper alignment. Do not bend ne breaker arm.

TAPPET SETTINGS

MODEL	INT.	EXH.	MODEL	INT.	EXH
N50-N62 N56-Spec 12 N62-Spec 11-24 N62 Roto	.012 .015 .015 .012	.012 .015 .015 .012	F186 F6186 F6209 F209 F6226 F226 F6226 Roto	.014	.014
Y4069 Y69 Y4091 Y91 Y91-Spec 380	.012 .015	.012 .015	M6271 M271 M6290 M290 M6330 M330	.017	.020
Y4112 Y112	.012	.012	M600 Series Roto	.017	.020
F4124 F124 F4140 F140 F4162 F162 F4162 Roto	.014	.014	B6371 B371 B6427 B427	.017	.022
			B6427 Roto	.017	.022

"L" HEAD ENGINE LUBRICATING OIL RECOMMENDATIONS

Engine Series	When Temperatures Are		
	Over 50°F	50°F to 20°F	20°F to 0°F
N50	SAE 30	SAE 20W	SAE 10W
N62	SAE 30	SAE 20W	SAE 10W
Y69	SAE 30	SAE 20W	SAE 10W
Y91	SAE 30	SAE 20W	SAE 10W
Y112	SAE 30	SAE 20W	SAE 10W
Y4069	SAE 30	SAE 20W	SAE 10W
Y4091	SAE 30	SAE 20W	SAE 10W
Y4112	SAE 30	SAE 20W	SAE 10W
F124	SAE 30	SAE 20W	SAE 10W
F140	SAE 30	SAE 20W	SAE 10W
F162	SAE 30	SAE 20W	SAE 10W
F4124	SAE 30	SAE 20W	SAE 10W
F4140	SAE 30	SAE 20W	SAE 10W
F4162	SAE 30	SAE 20W	SAE 10W
F186	SAE 30	SAE 20W	SAE 10W
F209	SAE 30	SAE 20W	SAE 10W
F226	SAE 30	SAE 20W	SAE 10W
F6186	SAE 30	SAE 20W	SAE 10W
F6209	SAE 30	SAE 20W	SAE 10W
F6226	SAE 30	SAE 20W	SAE 10W
M271	SAE 40	SAE 30	SAE 10W
M290	SAE 40	SAE 30	SAE 10W
M330	SAE 40	SAE 30	SAE 10W
M6271	SAE 40	SAE 30	SAE 10W
M6290	SAE 40	SAE 30	SAE 10W
M6330	SAE 40	SAE 30	SAE 10W
B427	SAE 40	SAE 30	SAE 10W
B6371	SAE 40	SAE 30	SAE 10W
B6427	SAE 40	SAE 30	SAE 10W

OIL AND WATER CAPACITY
OIL PRESSURE DATA

Model	Oil Capacity in Qts.		Oil Pressure* (1800 RPM)	Water Capacity (Qts.)	
	Pan	Filter		Engine	Engine & Radiator
-50	3½	½	20-30		11
-62	3½	½	20-30		11
69	3½	½	30-40		14
91	3½	½	30-40		15
112	3½	½	30-40		15
4069	3½	½	30-40	3¾	
4091	3½	½	30-40	3¾	
4112	3½	½	30-40	3¾	
124	4	½	20-30		14
140	4	½	20-30		14
162	4	½	20-30		15
4124	4	½	30-40	5	
4140	4	½	30-40	5	
4162	4	½	30-40	5	
186	5	½	20-30		17
209	5	½	20-30		17
226	5	½	20-30		17
6186	5	½	30-40	6½	
6209	5	½	30-40	6½	
6226	5	½	30-40	6½	
271	7	1	30-40		31
290	7	1	30-40		31
330	7	1	30-40		33
6271	7	1	40-50	13½	
6290	7	1	40-50	13½	
6330	7	1	40-50	13½	
371	8	1	30-40		36
6371	8	1	40-50	16	
6427	8	1	40-50	16	
427	8	1	40-50		36

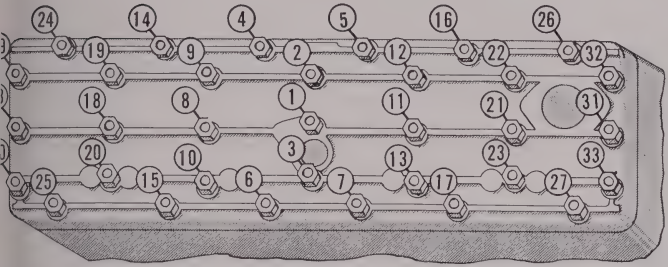
ssure at low idle RPM will be lower than these figures; this is satisfactory
ong as pressure does not fall below 5#.

TORQUE WRENCH DATA

Size	Limit in Foot Pounds Torque
Cylinder Heads	
⅜	35- 40
7/16	70- 75
½	100-110
9/16	130-140
⅝	145-155
Main Bearing Caps & Connecting Rods	
5/16	20- 25
⅜	35- 40
7/16	70- 75
½	85- 95
9/16	100-110
Flywheels	
5/16	20- 25
⅜	35- 40
7/16	70- 75
½	85- 95
9/16	100-110
⅝	145-155

Size	Limit in F Pounds To
Manifolds	
5/16	15
⅜	25
7/16	50
½	80
9/16	100
⅝	130
Gear Covers, Water Pumps, Front & Rear End Plates, Oil Pans	
5/16	15
⅜	25
7/16	50
½	80
Flywheel Housings	
5/16	15
⅜	25
7/16	50
½	80
9/16	115

CYLINDER HEAD TIGHTENING SEQUENCE



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26
19
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32
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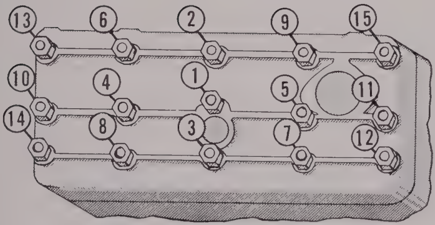
27

6 Cylinder Engines



13
6
2
9
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10
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11
14
8
3
7
12

4 Cylinder Engines

prevent distortion of cylinder and head castings, tighten cylinder head stud nuts or screws in order of above designations.

WHEN ORDERING SPARE PARTS BE SURE TO SPECIFY THE FO LOWING INFORMATION WHICH CAN BE FOUND ON THE ENGIN NAMEPLATE ON THE SIDE OPPOSITE THE MANIFOLD:

ENGINE MODEL
ENGINE SERIAL NUMBER
SPECIFICATION NUMBER—When indicated

Your cooperation in giving the above data will be of material assistance filling your orders promptly and correctly.

WARRANTY

for

Red Seal

TRANSPORTATION AND INDUSTRIAL ENGINES

The Continental Motors Corporation warrants each new engine manufactured by same to be free from defects in material and workmanship on the basis of installations and applications as herein defined.

1. BUS and TRUCK EQUIPMENT - Six months from date of shipment but not to exceed ninety days or 15,000 miles of service.
2. RAIL CARS and LOCOMOTIVES - Six months from date of shipment but not to exceed ninety days or 15,000 miles of service.
3. AGRICULTURAL EQUIPMENT - Six months from date of shipment but not to exceed ninety days of service.
4. INDUSTRIAL and OIL FIELD EQUIPMENT - Six months from date of shipment but not to exceed ninety days of service.
5. MARINE EQUIPMENT - One year from date of shipment.
6. FIRE EQUIPMENT - One year from date of shipment.

The obligation under this Warranty, statutory or otherwise, is limited to the replacement or repair at the Manufacturer's factory, or at a point designated by the Manufacturer, of such part as shall be found by the Manufacturer, upon inspection at such point, to have been defective in material or workmanship.

This Warranty does not obligate the Manufacturer to bear the cost of labor or transportation charges in connection with the replacement or repair of defective parts, nor shall it apply to an engine upon which repairs or alterations have been made unless authorized by the Manufacturer.

The Manufacturer makes no Warranty in respect to trade accessories, such being subject to the Warranties of their respective manufacturers.

The Manufacturer shall in no event be liable for consequential damages or contingent liabilities arising out of the failure of any engine or parts to operate properly.

No express, implied or statutory Warranty other than herein set forth is made or authorized to be made by the Manufacturer.

Before consideration can be given to requests for adjustments covering field service and alleged defective material, the Buyer shall furnish CONTINENTAL MOTORS CORPORATION with the following data:

Owner's name and address
Engine Model
Serial Number

Information as to the nature of the trouble
Date actually placed in service
Accumulated days or miles of service

Continental Motors Corporation

MUSKEGON, MICHIGAN

SERVICE MANUAL INDEX

Hendrickson Motor Truck Co. Ten Ton Crane Carrier

Section	
1	Budd Wheels
2	Service Brakes
3	Air Brake Piping Diagram
4	Emergency Brakes
5	Clutch
6	Engine
7	Carburetor
8	Air Cleaner
9	Electrical Wiring Diagram
10	Ignition and Lighting
11	Radio Suppression
12	Propeller Shafts and Universal Joints
13	Steering Gear
14	Transmission
15	Transfer Case
16	Chassis Lubrication Diagram
17	Engine Lubrication Diagram

VENDOR: The Budd Company	APPLICATION & MAINTENANCE OF BUDD WHEELS

(1) - Mounting faces of hub, wheel, and nut must be free from dirt or excess paint. Mounting faces which have been damaged from wear or abuse must be repaired or replaced.

(2) - Right hand threads are used on right side of vehicle and left hand threads on left side of vehicle.

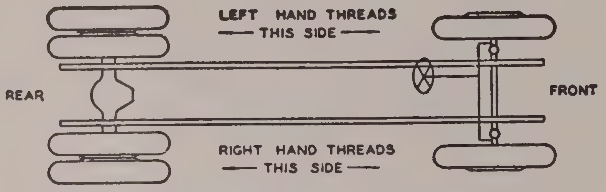
(3) - Heavier vehicles have 3/4 In. and larger studs and nuts. These nuts have real work to do and strength is required to tighten. Pressure should be 300 to 450 ft. lbs. depending upon severity of service and thickness of disc center. Use an extension on wrench handle.

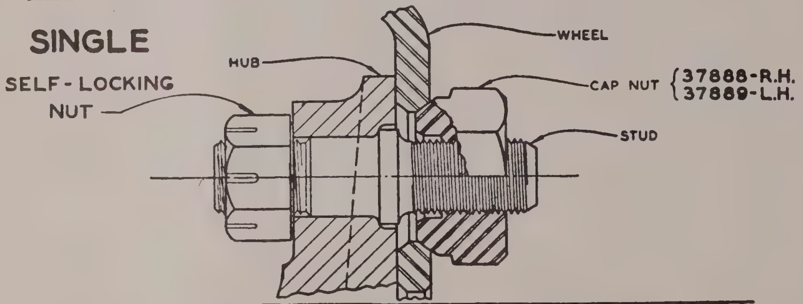
(4) - On dual wheels the outer nut should be backed off before attempting to tighten the inner nut. Try all cap nuts after the first trip or any wheel change. An occasional check of nuts for tightness is desirable. Properly installed they should remain tight indefinitely.

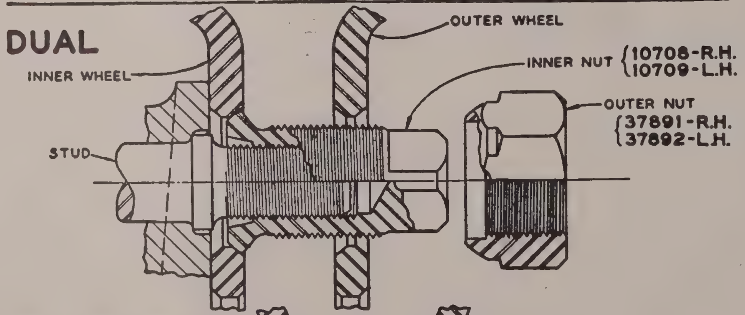
(5) - Valve stems on inner and outer wheels should be mounted in a different circumferential position for easy inflation of tires.

(See Other Side)

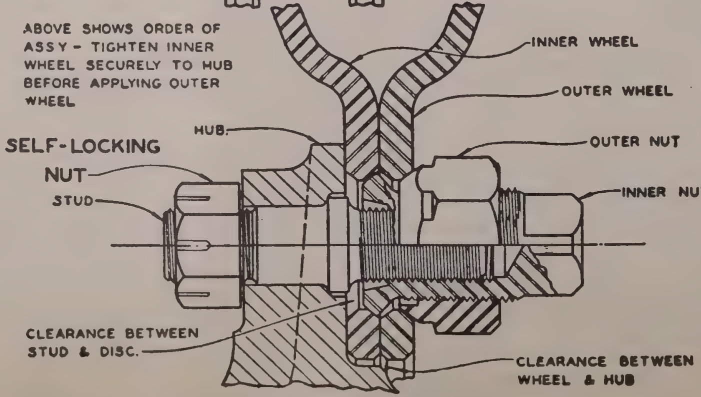
THE BUDD COMPANY


LEFT HAND THREADS
THIS SIDE
REAR
FRONT
RIGHT HAND THREADS
THIS SIDE


SINGLE
SELF-LOCKING NUT
HUB
WHEEL
CAP NUT {37888-R.H. 37889-L.H.
STUD


DUAL
INNER WHEEL
OUTER WHEEL
INNER NUT {10708-R.H. 10709-L.H.
OUTER NUT {37891-R.H. 37892-L.H.
STUD

ABOVE SHOWS ORDER OF ASSY - TIGHTEN INNER WHEEL SECURELY TO HUB BEFORE APPLYING OUTER WHEEL


SELF-LOCKING NUT
STUD
HUB
INNER WHEEL
OUTER WHEEL
OUTER NUT
INNER NUT
CLEARANCE BETWEEN STUD & DISC.
CLEARANCE BETWEEN WHEEL & HUB

VENDOR: Bendix-Westinghouse Automatic Air Brake Company	SERVICE BRAKES ·Low Pressure Indicator ·Double Check Valves ·Safety Valve

LOW PRESSURE INDICATOR

ESCRIPTION

The Low Pressure Indicator is a safety device designed to automatically give a
arning to the driver whenever the air pressure in the Air Brake System is below the
inimum advisable for normal vehicle operation. It is usually used to control an elec-
ical buzzer or warning light.

The Low Pressure Indicator consists of a die cast body and cover between which is
lamped a spring loaded rubber diaphragm. Electrical contacts and terminals are pro-
ided and the electrical contacts will remain closed until the air pressure below the
iaphragm is above the nominal setting of 60 pounds.

PERATION

When the reservoir air pressure under the diaphragm is above 60 pounds, the
lectrical contacts remain open because the force exerted by the air pressure over-
omes the force exerted by the diaphragm spring above the diaphragm.

When the reservoir air pressure drops below 60 pounds, the diaphragm spring
xerts a force above the diaphragm which is greater than the force exerted by the air
ressure below the diaphragm. This will cause the diaphragm to move down and close
e electrical contacts. This completes or closes the electrical circuit to the elec-
ical buzzer or warning light informing the driver of his impending loss of air
ressure.

The nominal pressure setting of 60 pounds is subject to a tolerance of plus or
inus 6 pounds so that the actual operating pressure of the Low Pressure Indicator
ay vary between 66 pounds maximum and 54 pounds minimum.

REVENTIVE MAINTENANCE

. Every month or after each 10,000 miles
  1. Check electrical connections.

. Every year or after each 50,000 miles
  1. Disassemble the Low Pressure Indicator and clean all parts. Replace the Diaphragm.

ESTING FOR SERVICEABILITY

. Operating Test
  1. Operation of the Low Pressure Indicator may be checked by reducing the reservoir pressure and being sure that the contacts close when the reservoir pressure is between 66 pounds maximum and 54 pounds minimum. The contacts will be closed when the warning light or electrical buzzer operate.

. Leakage Test
  1. A small vent hole is provided in the cover of the Low Pressure Indicator to check the condition of the diaphragm. Cover the vent hole with soap suds and if a leak is indicated it signifies a ruptured diaphragm. The diaphragm should then be replaced.

EMOVING

If it is necessary to remove the Low Pressure Indicator from the vehicle, the

REMOVING (Continued)

following procedure should be observed:

1. The ignition switch should be turned to the "off" position.
2. Drain the air from the air brake system.
3. Disconnect the electrical connections at the Low Pressure Indicator.
4. Disconnect the air line to the Low Pressure Indicator.
5. Remove the Low Pressure Indicator mounting bolts and remove the Low Pressure Indicator.

INSTALLING

When installing a Low Pressure Indicator on a vehicle the following procedure should be observed:

1. Install in a convenient location for servicing.
2. Connect pipe tap to a convenient reservoir pressure line and keep high for adequate drainage.
3. Install with the pipe tap pointing to the ground.
4. Use 1/4 In. or 3/8 In. O.D. tubing line to the Low Pressure Indicator.
5. Connect the Low Pressure Indicator terminals in series with the ignition switch and a 6 or 12 volt buzzer or warning light.

DISASSEMBLY

Unscrew the cover retainer from the body of the Low Pressure Indicator.

Remove the cover and lift out the spring and diaphragm assembly.

CLEANING AND INSPECTION

Clean all metal parts in cleaning solvent. Examine the diaphragm for signs of cracking, wear or damage. Replace the diaphragm if these conditions are found.

Inspect the contact points for signs of pitting or wear. If pitting is not too severe, the contacts may be reconditioned by filing them with a fine file such as used for distributor points. If they cannot be reconditioned, they should be replaced.

Check the spring for tension. If it has lost its tension, it should be replaced.

If the body or cover are cracked or damaged, they should be replaced.

ASSEMBLY

Place and position the diaphragm assembly in the body.

Place the spring so that it will be on the upper diaphragm follower.

Place the cover over the diaphragm. Attach the cover retainer to the body.

TEST OF REBUILT LOW PRESSURE INDICATOR

Both operating and leakage tests must be made after rebuilding or repairing the Low Pressure Indicator and it must meet the following specifications:

1. No leakage is permissible at the vent hole of the Low Pressure Indicator with air pressure in the air brake system.
2. The Low Pressure Indicator contacts should close at a pressure between 66 and 54 pounds.

DOUBLE CHECK VALVES

DESCRIPTION

Double Check Valves are used in our air brake systems where it is necessary to automatically direct the flow of air pressure into a common line from either of two other lines.

VENDOR: Bendix-Westinghouse Automatic Air Brake Company	SERVICE BRAKES ·Low Pressure Indicator ·Double Check Valves ·Safety Valve

DESCRIPTION (Continued)

Our two types of Double Check Valves are the Shuttle Type and Disc Type.

The Shuttle Type Double Check Valve consists of a die cast Body and two End Caps. Inside the valve are two rubber seal gaskets and brass metal shuttle.

The Disc Type Double Check Valve consists of a cast body and two End Caps. Inside the valve is a rubber disc and a disc guide. One end of the End Cap serves as the disc seat; the other end is tapped for air line connection.

Fundamentally, the only difference in the design of the two valves is that the shuttle type has a movable metal shuttle which contacts rubber seats to seal off he line not being used, whereas the disc type has a movable rubber disc which contacts metal seats.

OPERATION

The Double Check Valve is used when two Brake Valves are used to control brakes of a vehicle such as in the case of the Independent Trailer Brake Control Equipment.

If the Double Check Valve was not used in such cases and either of the Brake Valves was moved to the applied position, reservoir pressure would escape through he open Exhaust Port of the other Brake Valve. The Double Check Valve blanks off he line leading to the other Brake Valve and in this manner prevents any loss of air through it.

The operation of either type of Valve is very simple. As air pressure enters either end of the Double Check, the pressure moves the metal shuttle or the rubber disc to the opposite end preventing any air escaping in that direction, but permitting t to flow out the side or common connection. It will be seen that the same action will ake place if the air pressure on one side of the disc or shuttle is higher than the air pressure on the other side and that it is not necessary for the cavity on one side of he disc or shuttle to be exhausted for the valve to operate. Both types of Valves are designed so that it is impossible for the disc or shuttle to block off the opening to he side connection.

PREVENTIVE MAINTENANCE

A. Every year or after each 50,000 miles
   1. Both types of valves should be dismantled and thoroughly cleaned about once each year.
      a. If a shuttle valve is used, replace the rubber seats.
      b. If a disc valve is used - replace the rubber disc.

TESTING FOR SERVICEABILITY

When the Double Check Valves are used in Independent Trailer Control Equipment he following tests can be performed:

A. Operating Test
   1. Apply the foot Brake Valve and note that the brakes apply on both the towing and towed vehicle.
   2. Release the foot Brake Valve and note that the brakes release on both the towing and towed vehicle.
   3. Apply the hand Brake Valve and note that the brakes apply only on the

TESTING FOR SERVICEABILITY (Continued)

towed vehicle.

4. Release the hand Brake and note that the brakes release on the towed vehicle.

B. Leakage Test
  1. Apply the foot brake valve and check for leakage at the exhaust port of the hand brake valve.
  2. Apply the hand brake valve and check for leakage at the exhaust port of the foot brake valve.
  3. Leakage of a three inch soap bubble in three seconds is permissible in either of the above tests. If leakage exceeds this specification, replace the rubber seal gaskets for Shuttle Type Double Check Valves or the disc in Disc Type Double Check Valves.

REMOVING

If it is necessary to remove the Double Check Valve from a vehicle, the following procedure should be observed:

1. Disconnect all air lines at the Double Check Valve.
2. Remove Double Check Valve mounting bolt and remove the valve.

INSTALLING

When installing a Double Check Valve on a vehicle, the following procedure should be observed:

1. Both types of Double Check Valves should be securely bolted to a frame member and preferably mounted with the end connection in a horizontal plane.
2. The Disc Type Double Check Valve should be mounted at/or very near the Service Line Cut-Out Cock when used with Independent Trailer Control Equipment.
3. Connect air lines from foot and hand brake valves to the end connections of the Double Check Valve. The side connection of the Double Check Valve should be connected to the Service Line Cut-Out Cock.

DISASSEMBLY

A. Shuttle Type
  1. Unscrew the two bolts and nuts that hold the End Caps to the Body.
  2. Remove End Caps.
  3. Remove Rubber Seal Gaskets.
  4. Remove metal Shuttle.

B. Disc Type
  1. Unscrew the two End Caps from the Body.
  2. Remove rubber disc.
  3. Remove disc guide.

CLEANING AND INSPECTION

A. Shuttle Type
  1. Clean all metal parts in cleaning solvent.
  2. Examine the rubber seal gaskets. If they show signs of cracking, wear or damage, they should be replaced.
  3. Inspect the metal Shuttle to be sure it is not cracked or broken.
  4. If the Body or End Caps are cracked or damaged, they should be replaced.

CLEANING AND INSPECTION (Continued)

B. Disc Type

1. Clean all metal parts in cleaning solvent.
2. Examine the rubber disc. If it shows signs of cracking, wear or damage, it should be replaced.
3. Inspect the End Cap seats. If they are pitted, scratched or damaged, they should be replaced.
4. If the Body is cracked or damaged it should be replaced.

ASSEMBLY

A. Shuttle Type

1. Insert metal Shuttle in the Body.
2. Place rubber seal gaskets in the ends of the Body with the smooth surface of the seal gaskets facing toward the metal Shuttle.
3. Place the End Caps over the rubber seal gaskets and with the two bolts and nuts securely tighten the End Caps to the Body.

B. Disc Type

1. Insert disc guide in Body.
2. Insert rubber disc in guide.
3. Screw the End Caps to the valve Body.

TEST OF REBUILT DOUBLE CHECK VALVES

Both operating and leakage tests as previously described must be made after re-uilding or repairing a Double Check Valve.

SAFETY VALVE

DESCRIPTION

The function of the Safety Valve is to protect the Air Brake System against ex-essive air pressures above 150 pounds.

The Safety Valve simply consists of a spring loaded Ball Check Valve which lifts nd permits air to exhaust to atmosphere if the pressure in the Reservoir rises bove its setting.

The Safety Valve is normally set to "blow off" at 150 pounds.

OPERATION

Should the reservoir pressure below the Ball Valve rise to a point above the etting of the Safety Valve, the force developed will overcome the force of the Regu-ating Spring holding the ball on its seat and the Ball will lift. This permits air to ass up into the Spring Cage and exhaust to atmosphere through the Exhaust Port. As oon as this exhaust reduces the pressure to the setting of the Safety Valve, the Regulating Spring forces the ball back on its seat stopping the exhaust.

In this way the Safety Valve opens and relieves pressures above its setting but emains closed at pressures below its setting.

Normally, the Safety Valve remains inoperative and only functions if for any eason the reservoir pressure rises above its normal limit.

PREVENTATIVE MAINTENANCE

A. Every year or after every 50,000 miles
   1. The Safety Valve should be removed and thoroughly cleaned.

TESTS FOR SERVICEABILITY

A. Operating Tests
   1. The Safety Valve may be tested to be sure it is operative by pulling the exposed end of the valve stem. This removes the spring load from the ball and permits the valve to exhaust. If the Safety Valve does not "blow off" when this is done, the ball must be stuck on its seat. The complete valve should be removed and dismantled for cleaning.

B. Leakage Test
   1. Leakage at the exhaust port in the spring cage should not exceed a three inch soap bubble in three seconds.

REMOVING

All that is necessary in order to remove the Safety Valve from a vehicle is to unscrew the complete valve from the reservoir.

INSTALLING

When installing a Safety Valve on a vehicle, the following procedure should be observed:

1. Install in convenient location on top of No. 1 or wet reservoir to facilitate servicing.
2. Mount the valve so as to protect it from excessive heat and wheel wash.
3. Mount horizontally with exhaust port on the bottom. The stem of the valve should be to the rear of the vehicle.

DISASSEMBLY

Unscrew the Spring Cage from the body of the Safety Valve. Lift the ball valve from the body and remove the spring, spring seat, and release pin from the spring cage.

CLEANING AND INSPECTION

Clean all parts in cleaning solvent.

Examine the ball valve for signs of pitting or scratches. If the ball valve cannot be reconditioned, it should be replaced.

Check the body and spring cage for cracks. Be sure the exhaust port in the spring cage is not plugged.

ASSEMBLY

Place the ball valve in the body of Safety Valve.

Place the Spring release pin and Spring seat in the Spring Cage and adjusting screw assembly.

Position the spring seat over the ball valve and screw the spring cage to the body.

TEST OF REBUILT SAFETY VALVES

Both operating and leakage tests must be made after rebuilding or repairing the Safety Valve and the valve must meet the following specifications:

1. Leakage at the exhaust port should not exceed a three inch soap bubble in three seconds.

VENDOR: Bendix-Westinghouse Automatic Air Brake Company	SERVICE BRAKES · Low Pressure Indicator · Double Check Valves · Safety Valve

TEST OF REBUILT SAFETY VALVES (Continued)

2. The Safety Valve should be set to ''blow off'' at approximately 150 pounds. The pressure setting may be adjusted by loosening the Lock Nut and turning the adjusting screw. Turning the adjusting screw clockwise, raises the pressure setting. Turning the adjusting screw counter-clockwise, lowers the pressure setting. The setting of the Adjusting Screw should be locked by tightening the Adjusting Screw Lock Nut after each adjustment. An accurate Test Gauge should be used when adjusting the pressure setting of the Safety Valve.

QUICK RELEASE VALVE

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

INSTRUCTION PAMPHLET

No. 5069

REVISED MARCH, 1951

1951, BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY

QUICK RELEASE VALVE

Section I . . . DESCRIPTION and OPERATION
Section II . . . . PREVENTIVE MAINTENANCE
Section III . . TESTING FOR SERVICEABILITY
Section IV . . . REMOVING and INSTALLING
Section V . . . . DISASSEMBLY
Section VI . . . CLEANING and INSPECTION OF PARTS
Section VII . . . . REPAIRS
Section VIII . . . . ASSEMBLY
Section IX . . . . TEST OF REBUILT QUICK RELEASE VALVE

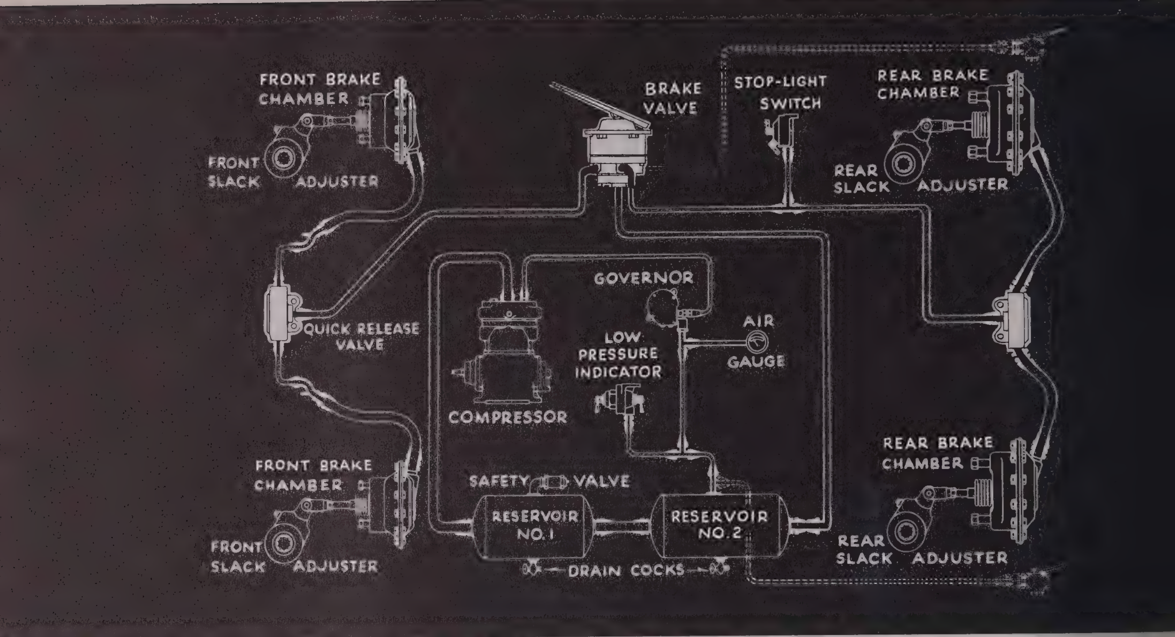

FRONT BRAKE CHAMBER
FRONT SLACK ADJUSTER
BRAKE VALVE
STOP-LIGHT SWITCH
REAR BRAKE CHAMBER
REAR SLACK ADJUSTER
GOVERNOR
QUICK RELEASE VALVE
LOW PRESSURE INDICATOR
AIR GAUGE
COMPRESSOR
FRONT BRAKE CHAMBER
REAR BRAKE CHAMBER
SAFETY VALVE
RESERVOIR NO. 1
RESERVOIR NO. 2
FRONT SLACK ADJUSTER
DRAIN COCKS
REAR SLACK ADJUSTER

FIG. 1—PIPING DIAGRAM OF QUICK RELEASE VALVE

Section I . . . DESCRIPTION and OPERATION

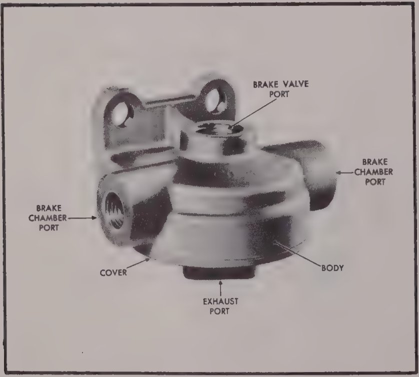

BRAKE VALVE PORT
BRAKE CHAMBER PORT
BRAKE CHAMBER PORT
COVER
BODY
EXHAUST PORT

FIG. 2—QUICK RELEASE VALVE

DESCRIPTION

The purpose of the quick release valve is to reduce the time required to release the brakes by hastening the exhaust of air pressure from the brake chambers. It may be used with either or both the front and rear wheel brake chambers.

The valve consists of a body containing a spring loaded diaphragm so arranged as to permit air pressure to flow through the valve in one direction but when the supply pressure is reduced, the air which has passed through the valve is permitted to escape through the exhaust port.

OPERATION

The quick release valve assumes three positions during normal operation. These three positions are the applying position, when air pressure is passing through the valve into the brake chambers; the holding position, when pressure is being held in the brake chambers; and the releasing position, when the brake chamber pressure is being exhausted.

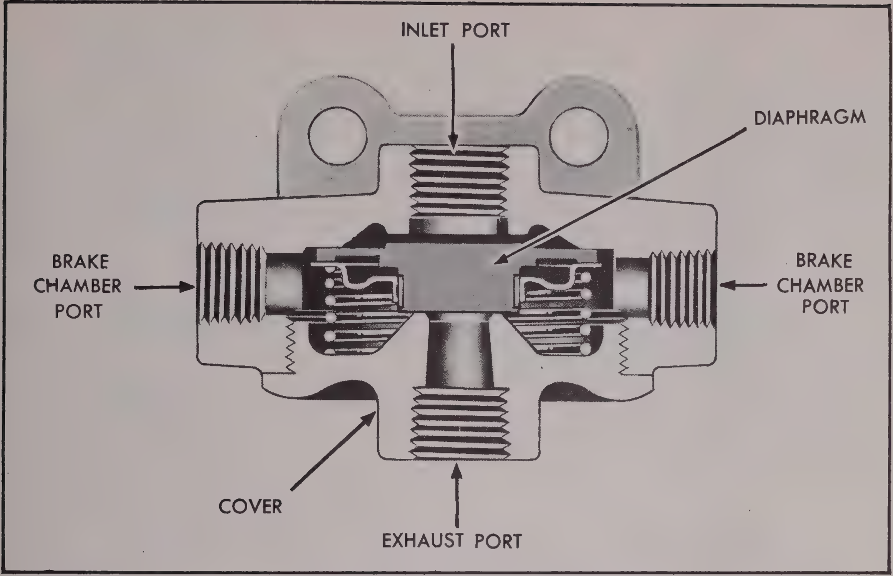

INLET PORT
DIAPHRAGM
BRAKE CHAMBER PORT
BRAKE CHAMBER PORT
COVER
EXHAUST PORT

FIG. 3—SECTIONAL VIEW OF QUICK RELEASE VALVE

When air pressure from the brake valve enters the top connection of the valve, the diaphragm moves down and closes the exhaust port. Air pressure then deflects the outer edges of the diaphragm downward and flows out the side connections to the brake chambers applying the brakes.

As soon as the brake chamber pressure below the diaphragm equals the brake valve pressure above the diaphragm, the force of the spring below the diaphragm forces the outer edge of the diaphragm back up against the body, although the center of the diaphragm keeps the exhaust port closed. This is the holding position.

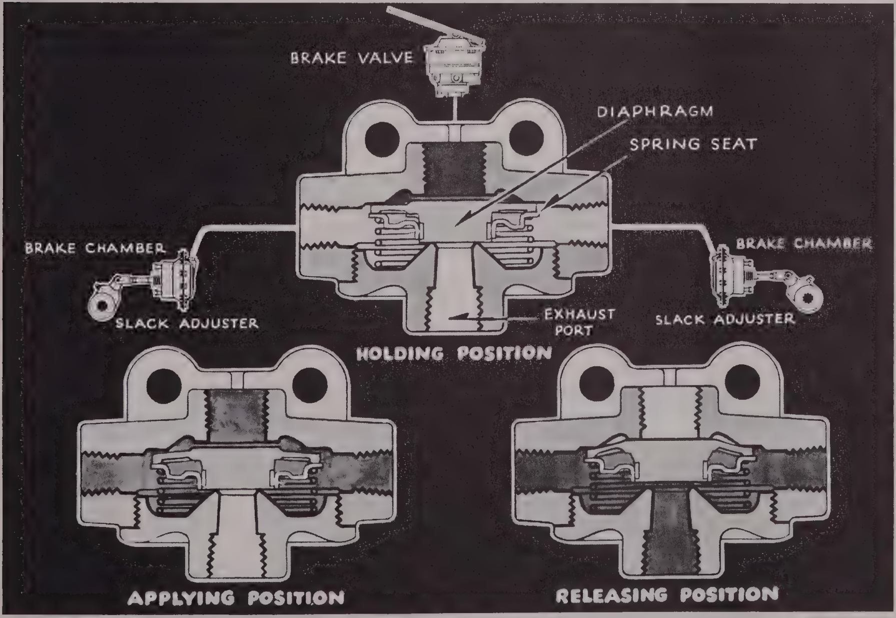

BRAKE VALVE
DIAPHRAGM
SPRING SEAT
BRAKE CHAMBER
BRAKE CHAMBER
SLACK ADJUSTER
EXHAUST PORT
SLACK ADJUSTER
HOLDING POSITION
APPLYING POSITION
RELEASING POSITION

FIG. 4—APPLYING, HOLDING AND RELEASING POSITIONS

If the brake valve pressure on top of the diaphragm is released, the brake chamber pressure below the center of the diaphragm raises it which opens the exhaust port and permits brake chamber pressure to be released through the exhaust port.

If the brake valve pressure on top of the diaphragm is only partially released, the diaphragm assumes its holding position as soon as the pressures above and below it are equalized.

In this manner the quick release valve reacts to pass any increased brake valve pressure through it to the brake chambers, or quickly releases the brake chamber pressure when the brake valve pressure is reduced and thus maintains the same pressure in the brake chambers as the brake valve is delivering.

Section II . . . . PREVENTIVE MAINTENANCE

Every year or after every 50,000 miles.

(1) Disassemble quick release valve and clean all parts (Section V and VI). Replace diaphragm.

Section III . . TESTING FOR SERVICEABILITY

OPERATING TESTS

Apply the brakes and observe that when the brakes are released, air pressure is quickly exhausted through the exhaust port of the valve. Be sure the exhaust port is not restricted in any way.

LEAKAGE TESTS

With brakes applied, coat the exhaust port with soap suds to detect leakage. Leakage in excess of a one inch soap bubble in one second is not permissible.

Section IV . . . REMOVING and INSTALLING

If it is necessary to remove or install the quick release valve the following procedure will apply:

REMOVING

(1) Disconnect air lines at quick release valve.

(2) Remove quick release valve mounting bolts and remove quick release valve.

INSTALLING

(1) Mount quick release valve in place.

(2) Connect air lines to quick release valve.

(3) Be sure exhaust port is open.

(4) Test quick release valve for serviceability (Section III).

Section V . . . . DISASSEMBLY

GENERAL

(1) Remove all dirt and grease from exterior of valve using cleaning solvent and a brush.

(2) Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

DISASSEMBLY

(1) Unscrew cover, lift out diaphragm spring, diaphragm spring seat and diaphragm.

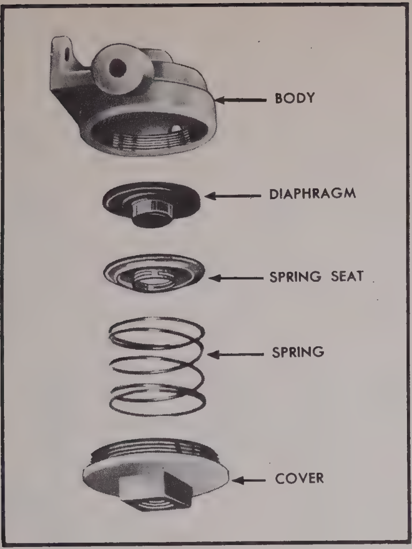


FIG. 5—EXPLODED VIEW OF QUICK RELEASE VALVE

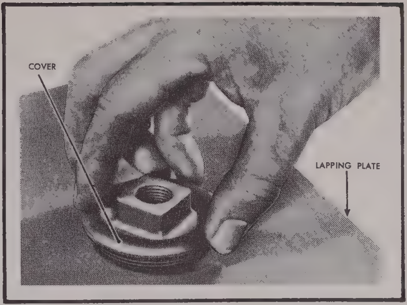


FIG. 6—LAPPING EXHAUST PORT SEAT

Section VI . . . CLEANING and INSPECTION OF PARTS

Clean all parts. Wash all metal parts in cleaning solvent.

Diaphragm. Examine diaphragm for signs of cracking, wear or damage. Carefully examine the lower face of the diaphragm which contacts the exhaust port seat in the cover for signs of pitting or grooving. Replace diaphragm if any of these conditions are found.

Cover. Inspect condition of exhaust port seat on cover for signs of pitting. The seat must be smooth and flat. If the exhaust port seat shows deep scratches or pitting, it must be replaced.

Spring Seat. If the spring seat is worn or damaged, replace with new spring seat.

Section VII . . . . REPAIRS

Cover. If the exhaust port seat on cover shows scratches or pitting, it can sometimes be repaired by carefully lapping the seat using a piece of fine emery cloth on a flat surface (Fig. 6).

Section VIII . . . . ASSEMBLY

a. Insert diaphragm into spring seat. Position diaphragm and spring seat in body and with spring in place, install and tighten cover securely.

Section IX . . TEST OF REBUILT QUICK RELEASE VALVE

If facilities are available the rebuilt quick release valve can be tested on a suitable test rack. If such facilities are not available, the quick release valve can be tested on the vehicle (Section III).

Both operating tests and leakage tests must be made in either case so the quick release valve meets the following specifications:

(1) The quick release valve must respond promptly when the brakes are released by exhausting air pressure through the exhaust port of the valve.

(2) Leakage at the exhaust port with the brakes applied must not exceed a one inch soap bubble in one second.

(3) Leakage at any other point on the quick release valve, with the brakes fully applied, is not permissible.

SAFETY STANDARD OF THE WORLD

Bendix-Westinghouse

BENDIX-WESTINGHOUSE
AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

Printed in U.S

TYPE U
COMPRESSORS

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

INSTRUCTION PAMPHLET
No. 5065

ISSUED NOVEMBER, 1948

TYPE U
COMPRESSORS

Section I . . . . . . DESCRIPTION and OPERATION
Section II . . . . PREVENTIVE MAINTENANCE
Section III . . . . . TESTING FOR SERVICEABILITY
Section IV . . . . . . REMOVING and INSTALLING
Section V . . . . DISASSEMBLY
Section VI . CLEANING and INSPECTION OF PARTS
Section VII . . . . REPAIRS
Section VIII . . . . ASSEMBLY
Section IX . . . . TESTING REBUILT COMPRESSORS
Section X . TROUBLE SHOOTING, TABULATED DATA, and SPECIAL TOOLS

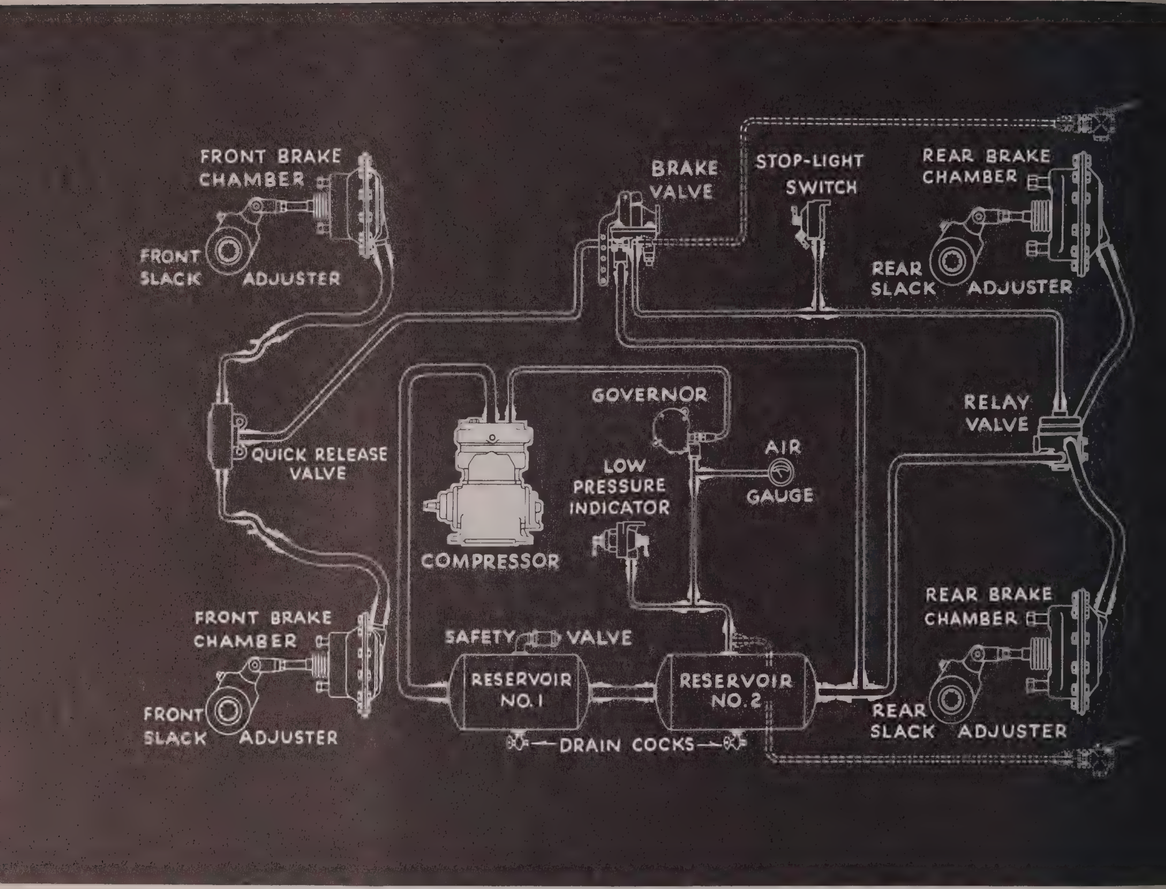

FRONT BRAKE CHAMBER
FRONT SLACK ADJUSTER
BRAKE VALVE
STOP-LIGHT SWITCH
REAR BRAKE CHAMBER
REAR SLACK ADJUSTER
GOVERNOR
RELAY VALVE
QUICK RELEASE VALVE
LOW PRESSURE INDICATOR
AIR GAUGE
COMPRESSOR
FRONT BRAKE CHAMBER
SAFETY VALVE
REAR BRAKE CHAMBER
RESERVOIR NO. 1
RESERVOIR NO. 2
FRONT SLACK ADJUSTER
REAR SLACK ADJUSTER
DRAIN COCKS

FIG. 1—PIPING DIAGRAM SHOWING A COMPRESSOR IN AN AIR BRAKE SYSTEM

Section I . . . . DESCRIPTION and OPERATION

FUNCTION

The function of the air compressor in an air brake system is to furnish the compressed air needed to operate the brakes. Also, the compressed air is often used to operate such auxiliary devices as doors and windshield wipers. With reference to Fig. 1, the compressor discharge line connects the compressor to the first reservoir. The compressor unloading line connects the compressor unloading mechanism to the governor.

DESCRIPTION

GENERAL. All type U compressors are the single acting reciprocating type and are made in a variety of designs and sizes to meet installation and service requirements. Their rated capacity is based on their piston displacement in cubic feet per minute when running at a speed of 1250 R.P.M. Sizes in use today have displacements of 4, 6, 7¼, or 12 cubic feet per minute although the manufacture of the 4 and 6 cubic foot sizes has been discontinued.

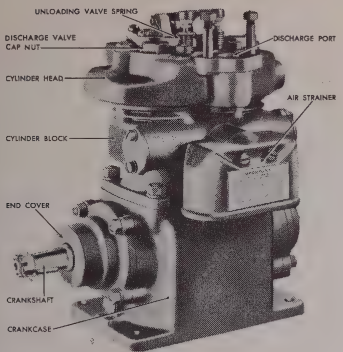

UNLOADING VALVE SPRING
DISCHARGE VALVE CAP NUT
DISCHARGE PORT
CYLINDER HEAD
AIR STRAINER
CYLINDER BLOCK
END COVER
CRANKSHAFT
CRANKCASE

FIG. 2—TYPICAL TWO CYLINDER ENGINE LUBRICATED COMPRESSOR

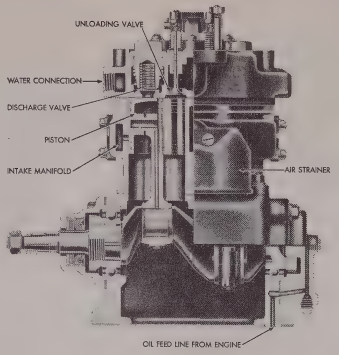

UNLOADING VALVE
WATER CONNECTION
DISCHARGE VALVE
PISTON
INTAKE MANIFOLD
AIR STRAINER
OIL FEED LINE FROM ENGINE

FIG. 3—SECTIONAL VIEW OF TYPICAL TWO CYLINDER ENGINE LUBRICATED COMPRESSOR

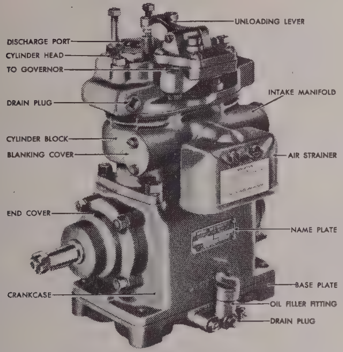

UNLOADING LEVER
DISCHARGE PORT
CYLINDER HEAD
TO GOVERNOR
INTAKE MANIFOLD
DRAIN PLUG
CYLINDER BLOCK
BLANKING COVER
AIR STRAINER
END COVER
NAME PLATE
BASE PLATE
CRANKCASE
OIL FILLER FITTING
DRAIN PLUG

FIG. 4—TYPICAL TWO CYLINDER SELF-LUBRICATED COMPRESSOR

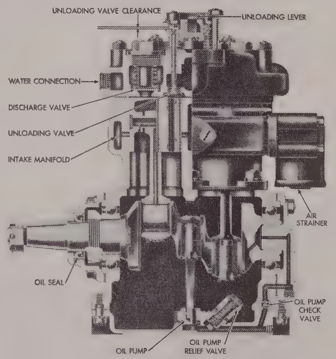

UNLOADING VALVE CLEARANCE
UNLOADING LEVER
WATER CONNECTION
DISCHARGE VALVE
UNLOADING VALVE
INTAKE MANIFOLD
AIR STRAINER
OIL SEAL
OIL PUMP CHECK VALVE
OIL PUMP
OIL PUMP RELIEF VALVE

FIG. 5—SECTIONAL VIEW OF TYPICAL TWO CYLINDER SELF-LUBRICATED COMPRESSOR

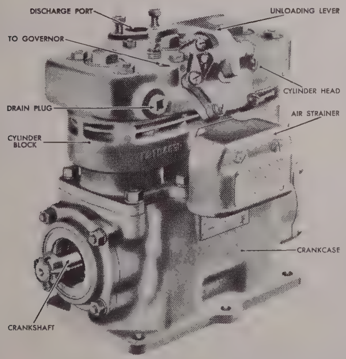

DISCHARGE PORT
UNLOADING LEVER
TO GOVERNOR
CYLINDER HEAD
DRAIN PLUG
AIR STRAINER
CYLINDER BLOCK
CRANKCASE
CRANKSHAFT

FIG. 6—TYPICAL THREE CYLINDER ENGINE LUBRICATED COMPRESSOR

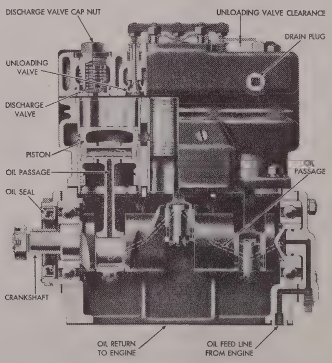
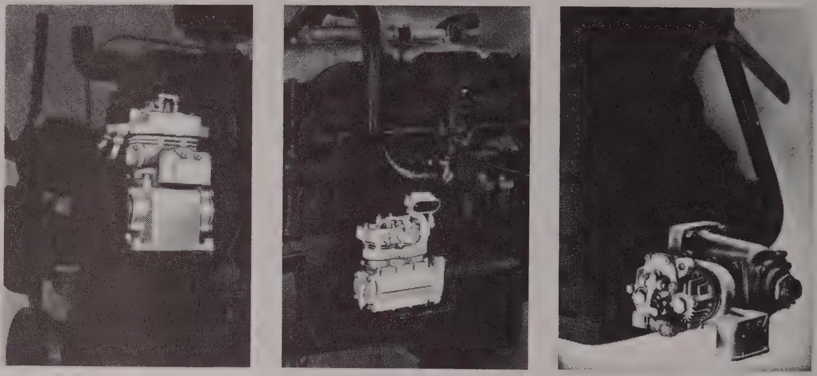

DISCHARGE VALVE CAP NUT
UNLOADING VALVE CLEARANCE
DRAIN PLUG
UNLOADING VALVE
DISCHARGE VALVE
PISTON
OIL PASSAGE
OIL PASSAGE
OIL SEAL
CRANKSHAFT
OIL RETURN TO ENGINE
OIL FEED LINE FROM ENGINE

FIG. 7—SECTIONAL VIEW OF TYPICAL THREE CYLINDER ENGINE LUBRICATED COMPRESSOR



VERTICAL FLANGE HORIZONTAL

FIG. 8—COMPRESSOR INSTALLATIONS

As shown in Fig. 8 all sizes are made in designs suitable for vertical, flange, or horizontal mounting and are fitted for belt, gear, or direct drive.

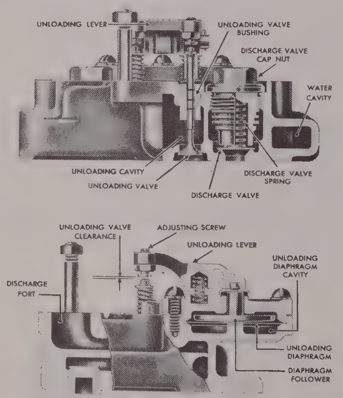

UNLOADING LEVER
UNLOADING VALVE BUSHING
DISCHARGE VALVE CAP NUT
WATER CAVITY
UNLOADING CAVITY
UNLOADING VALVE
DISCHARGE VALVE SPRING
DISCHARGE VALVE
UNLOADING VALVE CLEARANCE
ADJUSTING SCREW
UNLOADING LEVER
UNLOADING DIAPHRAGM CAVITY
DISCHARGE PORT
UNLOADING DIAPHRAGM
DIAPHRAGM FOLLOWER

FIG. 9—WATER COOLED COMPRESSOR CYLINDER HEAD

Most type U compressors have water cooled cylinder heads such as that shown in Fig. 9 but some have air cooled cylinder heads.

Fig. 10 shows two typical types of compressor oiling systems. With engine-lubricated compressors, oil pressure from the vehicle's engine enters the compressor through a passage in the crankcase, being fed to the connecting rod bearings through drilled holes in the crankshaft and to the wrist pin bearings through drilled holes in the connecting rods. The main bearings are ball bearings and are splash-lubricated. Surplus oil returns to the engine crankcase through the open compressor base.

Self-lubricated compressors have an oil reservoir in the crankcase and a piston type oil pump driven by the crankshaft. The oil pump relief valve controls the oil pressure developed and circulated to the connecting rod bearings and wrist pin bearings. Surplus oil returns to the compressor crankcase to be recirculated.

IDENTIFICATION. All compressors are identified by the piece number stamped on the name plate riveted to the side of the crankcase. Name plates also show the serial number and type of the compressor but compressors cannot be identified by the serial number or the type designation.

The type designation shown on the name plate is in accordance with the following:

Number of Cylinders	2 or 3
Type of Compressor	U
Lubrication	Engine-E or Self-S
Rated Capacity	4, 6, 7¼ or 12
Type of Mounting, Flange-F, Horizontal-H, Vertical-V	
Type of Cooling	Air-A, Water-W

Thus a 2 UE 7¼ VW compressor is a two cylinder, type U, engine-lubricated compressor with a displacement of 7¼ cubic feet per minute at 1250 R.P.M., vertically mounted and water-cooled.

OPERATION

All type U compressors run continuously while the engine is running but the actual compression of air is controlled by the governor which, acting in conjunction with the unloading mechanism in the compressor cylinder head, starts or stops the compression of air by loading or unloading the compressor when the air pressure in the air brake system reaches the desired minimum (80-85 pounds) or maximum (100-105 pounds).

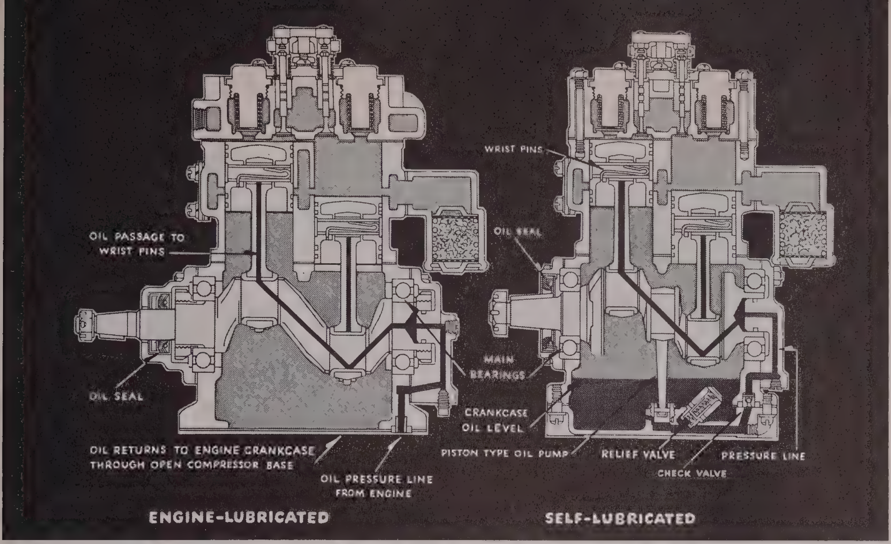

WRIST PINS
OIL PASSAGE TO WRIST PINS
OIL SEAL
OIL SEAL
MAIN BEARINGS
CRANKCASE OIL LEVEL
OIL RETURNS TO ENGINE CRANKCASE THROUGH OPEN COMPRESSOR BASE
OIL PRESSURE LINE FROM ENGINE
PISTON TYPE OIL PUMP
RELIEF VALVE
PRESSURE LINE
CHECK VALVE
ENGINE-LUBRICATED
SELF-LUBRICATED

FIG. 10—COMPRESSOR OILING SYSTEMS

COMPRESSING AIR. During the downstroke of each piston, a partial vacuum is created above the piston and as the piston nears the bottom of its stroke, it uncovers intake ports in the cylinder wall. Air then enters the cylinder above the piston by passing through the intake strainer, the intake manifold, and the intake ports in the cylinder wall.

As each piston begins its upstroke, it covers the intake ports in the cylinder wall and the air which has entered the cylinder is trapped above the piston. As the piston continues its upstroke, the air above the piston is compressed until the pressure lifts the discharge valve and the compressed air is discharged through the discharge line into the reservoir.

As each piston starts its downstroke, each discharge valve returns to its seat preventing the compressed air from returning to each cylinder and the same cycle is repeated.

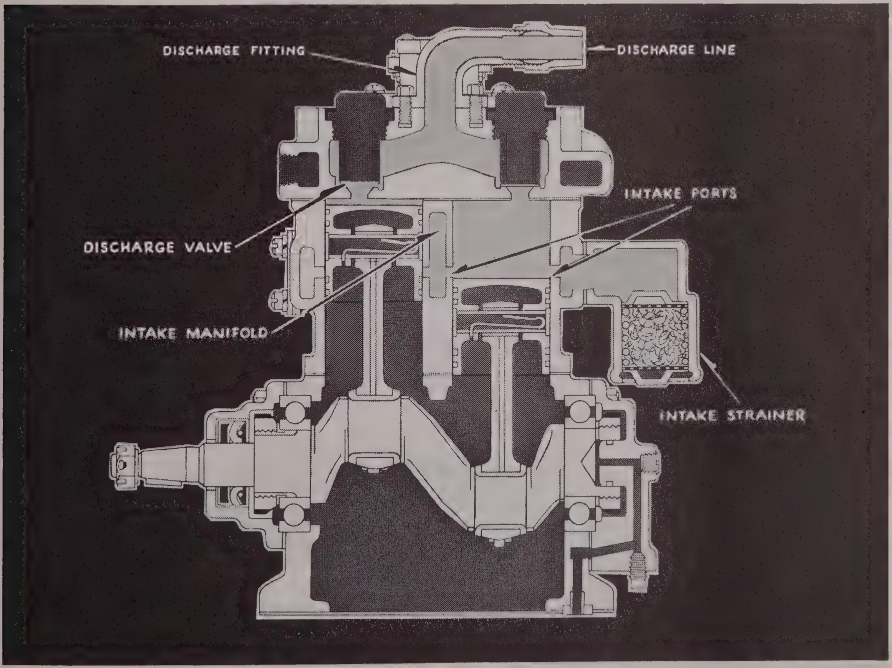

DISCHARGE FITTING
DISCHARGE LINE
INTAKE PORTS
DISCHARGE VALVE
INTAKE MANIFOLD
INTAKE STRAINER

FIG. 11—INTAKE AND COMPRESSION OF AIR

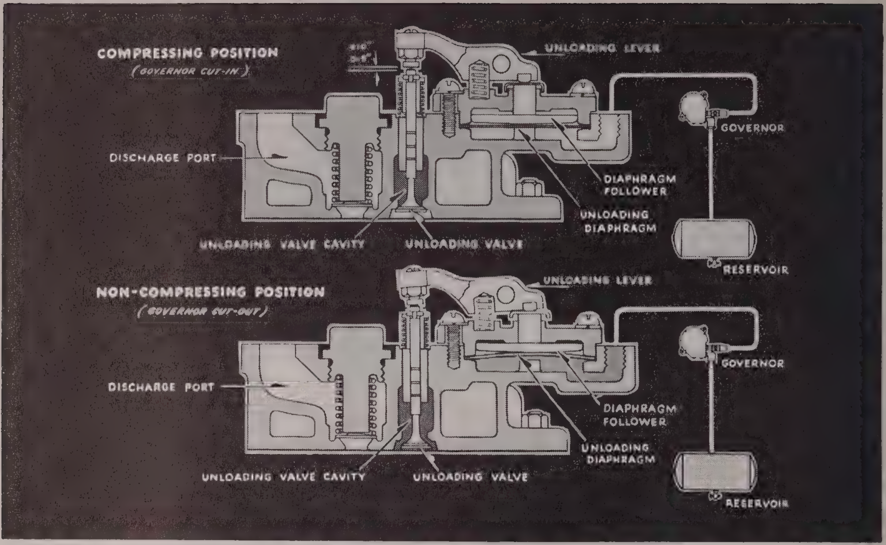

COMPRESSING POSITION
(GOVERNOR CUT-IN)
UNLOADING LEVER
GOVERNOR
DISCHARGE PORT
DIAPHRAGM FOLLOWER
UNLOADING DIAPHRAGM
UNLOADING VALVE CAVITY
UNLOADING VALVE
RESERVOIR
NON-COMPRESSING POSITION
(GOVERNOR CUT-OUT)
UNLOADING LEVER
GOVERNOR
DISCHARGE PORT
DIAPHRAGM FOLLOWER
UNLOADING DIAPHRAGM
UNLOADING VALVE CAVITY
UNLOADING VALVE
RESERVOIR

FIG. 12—COMPRESSOR UNLOADING MECHANISM

NOT COMPRESSING AIR (Unloaded). When the air pressure in the reservoir reaches the maximum setting of the governor, air pressure passes through the governor into the cavity below the unloading diaphragm in the compressor cylinder head. This air pressure lifts the unloading diaphragm and one end of the unloading lever. The unloading lever then pivots on its pin and the other end pushes the unloading valves off their seats.

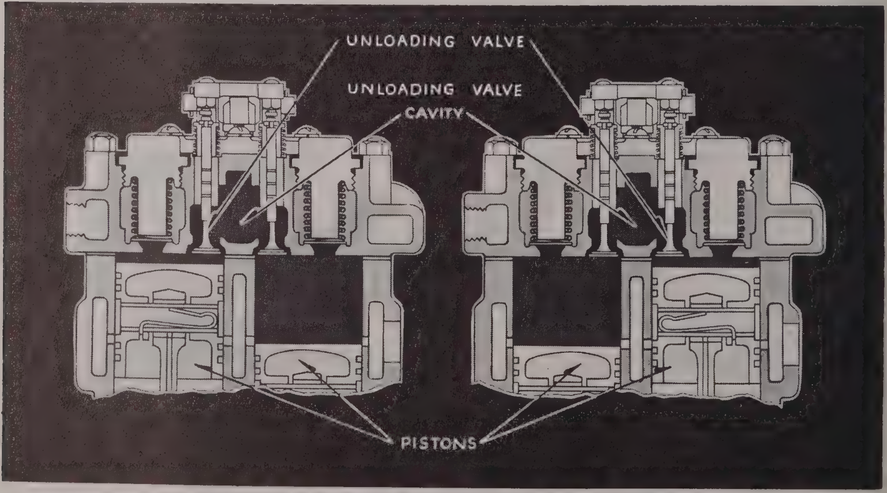

UNLOADING VALVE
UNLOADING VALVE CAVITY
PISTONS

FIG. 13—PASSAGE OF AIR DURING NON-COMPRESSION

With the unloading valves off their seats, the unloading cavity forms a passage between the cylinders above the pistons. Thus during the upstroke of each piston, are merely passes back and forth through this passage and compression is stopped. When the air pressure in the reservoir drops to the minimum setting of the governor, the governor releases the air pressure from beneath the unloading diaphragm. The unloading valve springs then return the unloading valves to their seats and compression is resumed.

Section II . . . . PREVENTIVE MAINTENANCE

DAILY SERVICE.. 1
EVERY MONTH OR AFTER EACH 2,000 MILES............ 2
EVERY SIX MONTHS OR AFTER EACH 10,000 MILES...... 3
EVERY TWO YEARS OR AFTER EACH 50,000 MILES........ 4

1. DAILY SERVICE

a. If the compressor is the self-lubricated type, check the oil level in the compressor crankcase and replenish if necessary. The oil level must be kept between the top of the oil filler fitting (full) and the lower end of the dip stick on the oil filler fitting cover (empty).

b. Should it be necessary to drain the engine cooling system to prevent freezing, always drain the compressor cylinder head.

2. EVERY MONTH OR AFTER EACH 2,000 MILES

a. Service compressor air strainer. Remove and wash all parts including curled hair in cleaning solvent. Saturate curled hair with clean engine oil and squeeze dry before replacing it in the strainer.

b. If compressor is the self-lubricated type, drain and flush compressor crankcase and refill with clean engine oil.

c. Check compressor mounting and drive for alignment, belt tension, etc. Adjust if necessary.

3. EVERY SIX MONTHS OR AFTER EACH 10,000 MILES

a. If the compressor is lubricated from the engine, clean oil supply line to compressor and oil return line to engine crankcase.

b. Check compressor unloading valve clearance and adjust if necessary (Fig. 15). Clearance must be 0.010 inch minimum to 0.015 inch maximum. To adjust clearance, loosen lock nuts and turn adjusting screws until proper clearance is obtained. Then tighten lock nuts. Clearance can be checked only when governor is cut in (compressor not unloaded). Check unloading valve lever for binding.

c. If compressor is the self-lubricated type, service crankcase breather. Wash breather in cleaning solvent.

d. Remove compressor discharge valve cap nuts and check for presence of excessive carbon. If excessive carbon is found, clean the compressor cylinder head; also check compressor discharge line for carbon and clean or replace the discharge line if necessary.

4. EVERY TWO YEARS OR AFTER EACH 50,000 MILES

a. Disassemble compressor, thoroughly clean all parts and inspect for wear or damage. Repair or replace all worn or damaged parts or replace compressor with a factory reconditioned repair exchange unit.

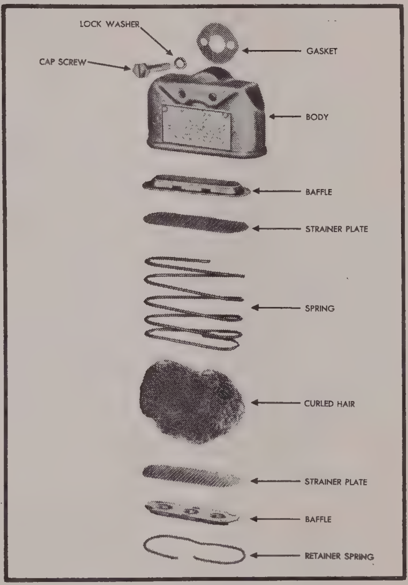


FIG. 14—EXPLODED VIEW OF TYPICAL COMPRESSOR AIR STRAINER

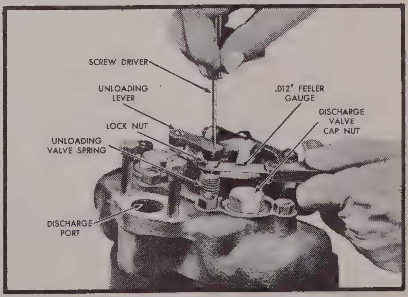


FIG. 15—ADJUSTING COMPRESSOR UNLOADING VALVE CLEARANCE

Section III . . . . . TESTING FOR SERVICEABILITY

a. Inspection.

(1) Be sure compressor air strainer is clean and properly installed. Also be sure blanking covers and gaskets are installed on all strainer openings not being used in the compressor intake manifold.

(2) With compressor running, check for noisy operation and oil or water leaks.

(3) Check unloader valve clearance.

(4) Check compressor drive for alignment, belt tension, etc.

(5) Check to be sure compressor mounting bolts are secure.

b. Operating Tests.

(1) Because of the many different types of air brake systems found on different types of vehicles, it is difficult to set up any specific series of tests to determine the serviceability of a compressor on a vehicle. Failure of the compressor to maintain normal air pressure in the air brake system of a vehicle usually denotes loss in efficiency due to wear, provided, leakage in the remainder of the system is not excessive. Another sign of wear is excessive oil passing. If either of these conditions develop and inspection shows the remainder of the air brake equipment to be in good condition, the compressor must be repaired or replaced.

c. Air Leakage Tests.

(1) Excessive leakage past the discharge valves can be detected by fully charging the air brake system and then with the engine stopped, carefully listening at the compressor for the sound of escaping air. This must be done in a quiet place and if air pressure can be heard escaping inside the compressor, the discharge valve leakage is excessive, and the compressor cylinder head or the complete compressor must be replaced.

(2) With the air brake system fully charged (governor cut out) coat the unloading box cover with soap suds to check for leakage past the unloading diaphragms. Leakage of a one inch soap bubble in three seconds is permissible. If excessive leakage is found, the compressor cylinder head or complete compressor should be repaired or replaced.

Section IV . . . . REMOVING and INSTALLING

a. Scope. The correct procedure for replacement of compressors varies with the design and type of the compressor and the vehicle engine. The following instructions are merely general and, in some cases, additional precautions must be taken.

b. Removal.

(1) Drain air brake system.

(2) Drain engine cooling system and compressor cylinder head if compressor is water cooled.

(3) Disconnect all air, water, and oil lines connected to the compressor.

(4) Remove compressor mounting bolts and remove compressor from engine.

(5) Use a gear puller to remove the gear or pulley from the compressor crankshaft after removing crankshaft nut.

c. Installation.

(1) ENGINE LUBRICATED TYPES.

(a) Clean oil supply line to compressor and, if possible, run engine a few seconds to be sure oil supply to compressor is flowing freely.

(b) Clean oil return line or passage through compressor mounting bracket to be sure oil from compressor can return to engine crankcase.

(c) If oil supply line passes through mounting bracket and compressor crankcase, be sure the oil passages in crankcase and mounting bracket are properly aligned.

(d) Lubricate compressor cylinder walls and bearings with lubricating oil before placing compressor in position.

(e) Always use a new mounting gasket and be sure oil hole in gasket is positioned properly so as not to block the oil supply line.

(2) SELF-LUBRICATED TYPES.

(a) Fill compressor crankcase with engine oil before operating the compressor.

(3) ALL TYPES.

(a) Inspect bore and keyway of pulley or gear for wear or damage. Pulley or gear must be a neat fit on compressor crankshaft. Replace pulley or gear if bore or keyway is damaged or worn.

(b) Install pulley or gear on compressor crankshaft being sure it properly contacts the shaft and does not ride the key. Tighten crankshaft nut securely and install cotter pin.

(c) Be sure the air strainer is clean and properly installed with no possibility of leakage at the gasket joint. Also be sure blanking covers and gaskets are installed on all strainer openings not being used in the compressor inlet manifold.

(d) Clean or replace any dirty air or water lines, before connecting them to the compressor. Always use a new discharge fitting gasket.

(e) Align compressor drive if necessary and adjust belt tension.

(f) Tighten mounting bolts securely and evenly.

d. CHECK AFTER INSTALLATION.

(1) With compressor running, check for noisy operation and oil, water, or air leaks.

(2) Check unloading valve clearance (Fig. 15).

(3) Test air brake system for serviceability.

Section V . . . . DISASSEMBLY

CLEANING BEFORE DISASSEMBLY........................ 1
MARKING BEFORE DISASSEMBLY........................ 2
REMOVING AND DISASSEMBLING CYLINDER HEADS... 3
REMOVING AND DISASSEMBLING BASE PLATES........ 4
REMOVING AND DISASSEMBLING PISTON AND CONNECTING ROD ASSEMBLIES........................ 5
REMOVING CRANKSHAFTS.............................. 6
REMOVING CYLINDER BLOCKS.......................... 7

1. CLEANING BEFORE DISASSEMBLY

a. Remove all grease or dirt from the exterior of the compressor by scraping, if necessary, followed by the use of cleaning solvent and a brush.

2. MARKING BEFORE DISASSEMBLY

a. The cylinder head, cylinder block, air strainer, and crankshaft of many compressors are designed so the compressor can be assembled in several different ways to meet installation requirements. In order to insure correct assembly, such parts should be marked before disassembly where necessary to show their correct position in relation to each other. This can be done best by making center punch marks in the related parts to act as guides during assembly. The following parts should be marked:

(1) Position of cylinder head in relation to cylinder block.

(2) Position of air strainer in relation to cylinder block.

(3) Position of cylinder block in relation to crankcase.

(4) Position of front end cover (drive end of crankshaft) in relation to the crankcase. (Make one punch mark on each).

(5) Position of rear end cover in relation to the crankcase. (Make two punch marks on each).

(6) Position of oil filler fitting in relation to base plate. (Self-lubricated compressors only).

b. All crankshafts are marked already with one punch mark on the throw nearest the drive end. Marking the crankcase with one punch mark at the drive end will permit the crankshaft to be properly positioned in the crankcase during assembly.

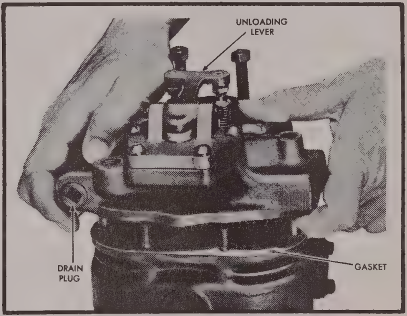


FIG. 16—REMOVING CYLINDER HEAD

3. REMOVING AND DISASSEMBLING CYLINDER HEADS

a. Remove nuts from all cylinder head studs and lift off cylinder head (Fig. 16). The cylinder head may have to be tapped lightly with a rawhide hammer to break the gasket joint.

b. Scrape cylinder head gasket off cylinder head and block.

c. Remove cotter pins from unloading lever. Drive out unloading lever pin and remove unloading lever, spring, and dust guard.

d. Remove machine screws attaching unloading box cover to cylinder head. Lift off box cover and remove diaphragm follower and two diaphragms.

e. Remove discharge valve cap nuts and lift out discharge valve springs and discharge valves.

f. By hand, compress unloading valve springs (Fig. 26) and remove spring retaining rings. Then remove unloading valve stops and unloading valve springs. Remove unloading valves by pushing them out the bottom of the cylinder head body.

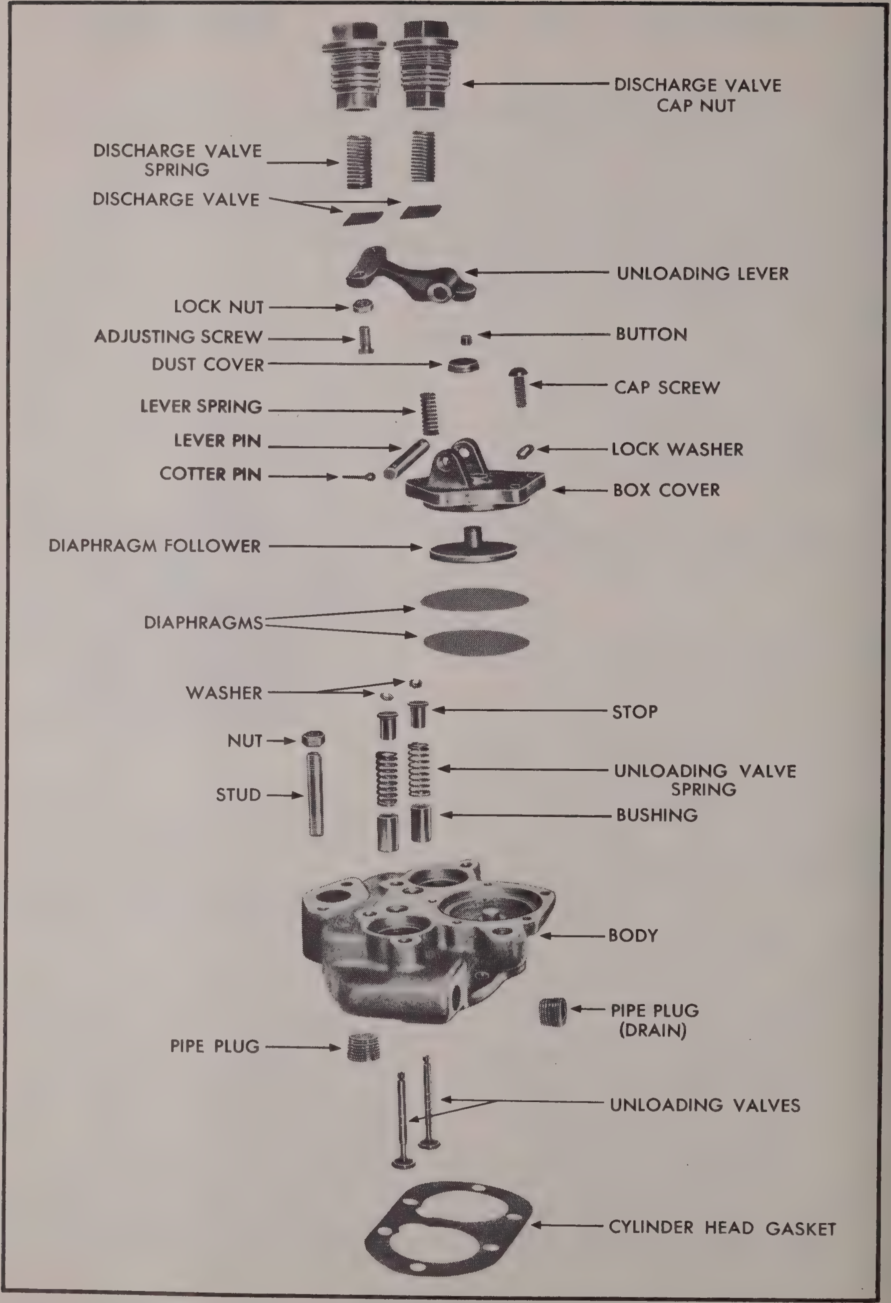

DISCHARGE VALVE CAP NUT
DISCHARGE VALVE SPRING
DISCHARGE VALVE
UNLOADING LEVER
LOCK NUT
ADJUSTING SCREW
BUTTON
DUST COVER
CAP SCREW
LEVER SPRING
LEVER PIN
LOCK WASHER
COTTER PIN
BOX COVER
DIAPHRAGM FOLLOWER
DIAPHRAGMS
WASHER
STOP
NUT
UNLOADING VALVE SPRING
STUD
BUSHING
BODY
PIPE PLUG (DRAIN)
PIPE PLUG
UNLOADING VALVES
CYLINDER HEAD GASKET

FIG. 17—EXPLODED VIEW OF TYPICAL TWO CYLINDER COMPRESSOR CYLINDER HEAD

REMOVING AND DISASSEMBLING BASE PLATES (SELF-LUBRICATED COMPRESSORS ONLY)

a. If the compressor is the self-lubricated type, remove the machine screws securing the base plate in place and lift off the base plate (Fig. 35). (In some three cylinder self-lubricated compressors having a large oil sump attached to the crankcase, the oil pump is located in the rear end cover. In such cases, the rear end cover assembly must be removed before removing the crankcase base plate.)

b. Unscrew oil pump relief valve from base plate. Drive out spring retaining pin at the top of the oil pump relief valve and lift out upper piston spring, piston and lower piston spring.

c. Remove spring retaining ring securing oil screen in place and lift out oil screen.

d. Do not remove oil pump piston bushing.

REMOVING AND DISASSEMBLING PISTON AND CONNECTING ROD ASSEMBLIES

a. If compressor is the self-lubricated type, remove cotter pins from castellated nuts on bolts attaching oil pump piston rod bearing cap. Remove oil pump piston rod and bearing cap. Replace bearing cap on oil pump rod to protect oil pump rod bearing. Do not remove oil pump piston from rod unless it is to be replaced. Remove by driving out oil pump piston pin.

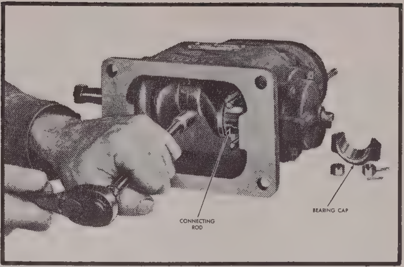

CONNECTING ROD
BEARING CAP

FIG. 18—REMOVING CONNECTING ROD BEARING CAPS

b. Remove cotter pins from castellated nuts on bolts attaching connecting rod bearing caps. Lift out the connecting rod bearing caps. Then push pistons, with connecting rods attached, out the top of the cylinder block. Replace cap on each connecting rod to avoid damage to bearings. Connecting rod caps and connecting rods are already marked with center punch marks to show proper position of caps.

c. Remove piston rings from each piston. If pistons are to be removed from connecting rods, remove wrist pin lock wires from each wrist pin and press wrist pins from pistons and connecting rods.

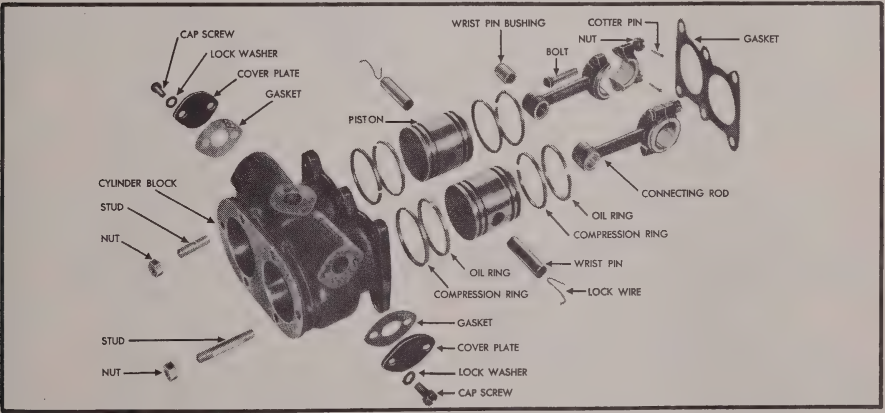

CAP SCREW
LOCK WASHER
COVER PLATE
GASKET
WRIST PIN BUSHING
COTTER PIN
NUT
BOLT
GASKET
PISTON
CYLINDER BLOCK
STUD
NUT
CONNECTING ROD
OIL RING
COMPRESSION RING
WRIST PIN
LOCK WIRE
OIL RING
COMPRESSION RING
GASKET
COVER PLATE
LOCK WASHER
CAP SCREW
STUD
NUT

FIG. 19—EXPLODED VIEW OF CYLINDER BLOCK SECTION OF TYPICAL TWO CYLINDER COMPRESSOR

6. REMOVING CRANKSHAFTS

a. Remove nuts and lock washers from studs securing front or drive end cover to crankcase. Remove end cover with oil seal and gasket. If oil seal needs replacing, remove it from end cover.

b. Remove nuts and lock washers from studs securing rear end cover to crankcase. Remove end cover and gasket. If rear end cover is fitted with an oil seal ring, remove oil seal ring.

c. If compressor is fitted with special lock nuts and lock washers at either or both ends of the crankshaft, bend up lugs on lock washers and remove lock nuts and lock washers.

d. Some crankcases are fitted with a shoulder to position crankshaft in place. In such cases, the crankshaft may only be removed through one end of the crankcase. Press crankshafts and ball bearings out of crankcases and press ball bearings off crankshafts.

7. REMOVING CYLINDER BLOCKS

a. If compressor is fitted with an air strainer, remove screws and lock washers securing air strainer in place and remove and disassemble air strainer (Fig. 14). Remove intake manifold covers and gaskets.

b. Remove nuts and lock washers securing cylinder block to crankcase and remove cylinder block and gasket.

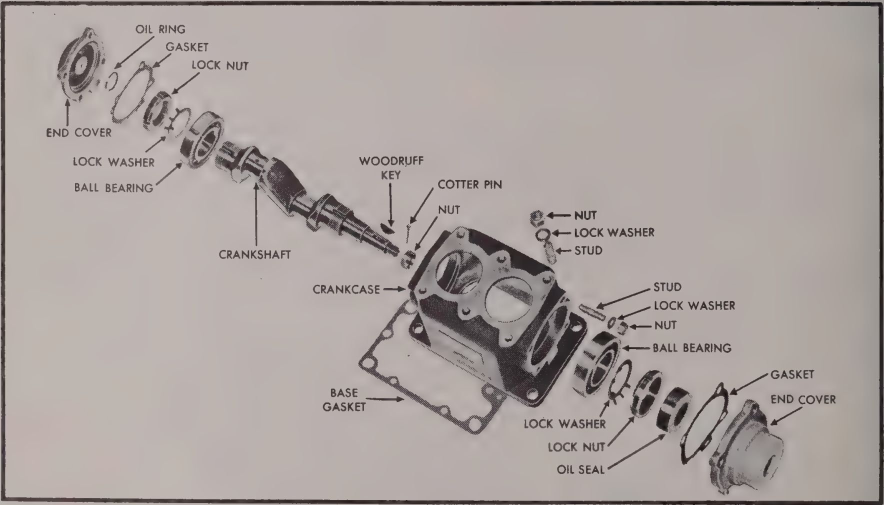

OIL RING
GASKET
LOCK NUT
END COVER
LOCK WASHER
BALL BEARING
WOODRUFF KEY
COTTER PIN
NUT
CRANKSHAFT
NUT
LOCK WASHER
STUD
CRANKCASE
STUD
LOCK WASHER
NUT
BALL BEARING
GASKET
END COVER
BASE GASKET
LOCK WASHER
LOCK NUT
OIL SEAL

FIG. 20—EXPLODED VIEW OF CRANKCASE SECTION OF TYPICAL TWO CYLINDER COMPRESSOR

Section VI . CLEANING and INSPECTION OF PARTS

CLEANING.. 1
INSPECTION OF PARTS.................................. 2

1. CLEANING

a. General. Clean all parts using cleaning solvent to remove all traces of dirt, oil, or grease before inspection.

b. Cylinder Head and Components.

(1) Put cylinder head body through a cleaning solution to remove all carbon from discharge valve cavities and unloading valve cavity and to remove all rust and scale from water cavity. If necessary, remove unloading valve bushings to facilitate removal of carbon from unloading valve cavity. Use air pressure to blow dirt out of all cavities. Scrape carbon, dirt, or particles of old gaskets from all surfaces.

(2) Clean discharge valves, not worn excessively or damaged, by lapping them on a piece of crocus cloth on a flat surface (Fig. 21).

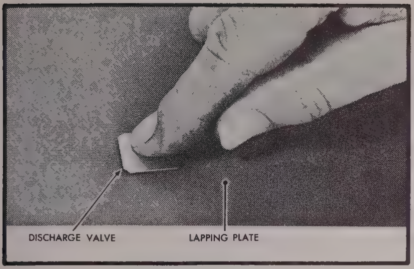


FIG. 21—CLEANING DISCHARGE VALVES

c. Oil Passages. Thoroughly clean all oil passages through crankshafts, connecting rods, crankcases, base plates and end covers. If necessary, prod oil passages with a piece of wire and flush with cleaning solvent.

d. Cylinder Block. Put cylinder block through a cleaning solution to remove all carbon or dirt from intake manifold and intake ports. If necessary, remove welsh plug in manifold to accomplish this.

e. Air Strainer. Wash curled hair in air strainer in cleaning solvent. Then saturate it in clean engine oil and squeeze out excess oil before replacing it in the strainer.

f. Crankcase Breather. If the compressor is the self-lubricated type having a crankcase breather, be sure it is washed thoroughly clean.

g. Ball Bearings. All ball bearings must be washed thoroughly in cleaning solvent.

h. Crankcase. If the compressor is the self-lubricated type having an oil pump check valve in the crankcase wall, remove and replace the check valve.

2. INSPECTION OF PARTS

a. Cylinder Head Body. Inspect cylinder head body for cracks or breaks. Replace if any are found. Check condition of unloading diaphragm seat in unloading diaphragm cavity in cylinder head. Replace cylinder head body if seat is pitted or damaged in any way.

b. Test Water Jacket. Test water jacket for leakage after cleaning using air pressure. If any leakage is found, the cylinder head body must be replaced.

c. Unloading Lever Pin. Check fit of unloading lever pin in unloading lever for excessive play. If pin or lever show signs of wear, either or both should be replaced.

d. Unloading Diaphragms and Box Cover. Check unloading diaphragms and replace if any signs of wear or cracking are present. Check diaphragm seat on bottom of unloading box cover. Lap seat or replace cover if necessary.

e. Unloading Valve Stems and Bushings. Check condition of slot in unloading valve stems where the retaining washers contact the valve stems. Replace unloading valves if any evidence of wear is present. Check fit of unloading valve stems in unloading valve bushings. Unloading valve stems must be a neat sliding fit in unloading valve bushings. If excessive clearance is found, check unloading valve stems for wear. Wear of the unloading valve stems must not exceed 0.002 inch. This may be checked by comparing the diameter of the unloading valve stem where it engages the bushing with the diameter of the stem where it does not engage the bushing. If there is excessive clearance between the unloading valve stems and the unloading valve bushings, the unloading valves, unloading valve bushings, or both must be replaced. If the unloading valve bushings are to be replaced, they are removed by pressing them out. Unloading valve bushings in two cylinder compressors must be pressed out through the top of the cylinder head. Unloading valve bushings in three cylinder compressors must be pressed out through the bottom of the cylinder head.

f. Discharge Valve Springs. Discard all used discharge valve springs and replace with new springs.

g. Discharge Valves and Seats. Inspect condition of discharge valves and discharge valve seats. If discharge valves are grooved deeper than 0.003 inch where they contact the seats, they should be replaced. If the discharge valve seats are worn excessively so there is no longer sufficient metal left to reclaim the seat by reaming, the cylinder head body should be replaced.

h. Oil Pump Piston and Bushing. If compressor is the self-lubricated type, check fit of oil pump piston in base plate oil pump bushing. Oil pump piston must be a neat sliding fit in oil pump bushing. If excessive clearance is found, the oil pump piston, the base plate or both must be replaced. If the oil pump piston bushing is loose in the base plate or if it shows any signs of being scored or damaged in any way, the base plate assembly with bushing must be replaced.

i. Oil Pump Relief Valve. Check fit of oil pump relief valve piston in relief valve body. Piston must be a neat sliding fit without any evidence of binding. Replace piston springs in oil pump relief valve.

j. Crankcase and End Covers. Check crankcase and end covers for cracks and broken lugs. Replace if any are found.

k. Oil Pump Check Valve. If compressor is the self-lubricated type having an oil pump check valve in one end of the crankcase wall, remove and replace the check valve. Check its condition by blowing air pressure back through the oil passage from the opening in the end of the crankcase. No leakage should be noticeable through the check valve.

l. End Covers. If an oil seal ring is used in the end cover, check fit of ring in the ring groove. Ring must be a neat fit in ring groove and have 0.008 inch to to 0.015 inch clearance at the gap when placed in the end bore of the crankshaft. Check lip of oil seal for wear. If worn thin, the oil seal must be replaced.

m. Crankcase Bearing Bores. Check fit of ball bearings in crankcase. Bearings must be a light press fit. If the crankcase bearing bores are worn or damaged, the crankcase should be replaced.

n. Oil Pump Screen. If compressor is the self-lubricated type, inspect condition of oil pump screen. Replace if damaged in any way.

o. Cylinder Blocks. Cylinder blocks with broken lugs or with cracks of any kind must be replaced.

p. Cylinder Bores. Check cylinder bores for evidence of excessive wear, out-of-roundness, or scoring. Cylinder bores which are scored or out-of-round more than 0.003 inch or tapered more than 0.003 inch should be rebored, ground, or honed oversize. Cylinder blocks should be finish ground while bolted to the crankcase. Oversize pistons are 0.010 inch, 0.020 inch or 0.030 inch oversize. Cylinder bores must be smooth, straight, and round and should be finished with a 320 grit hone. Clearance between pistons and cylinder blocks must be 0.002 inch minimum and 0.004 maximum.

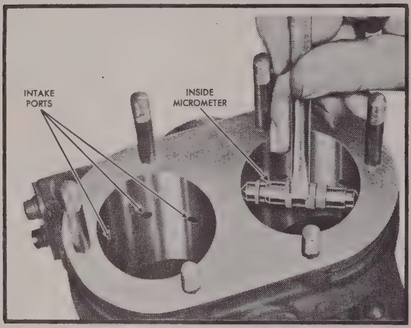


FIG. 22—MEASURING CYLINDER BORE DIAMETERS

q. Pistons. Inspect pistons for scores, cracks or damage of any kind. If scores or cracks are found, replace the piston. Check each piston with a micrometer in relation to the cylinder bore diameter to be sure the clearance is between 0.002 inch minimum and 0.004 inch maximum.

r. Piston Rings. Check fit of piston rings in the ring grooves. Clearance between the ring and the ring groove should not be less than 0.0015 inch nor more than 0.0025 inch. Piston rings which have a gap of more than 0.020 inch when positioned in the cylinder should be replaced. Clearance at the gap of new piston rings when installed in the cylinder must not be less than 0.010 inch nor more than 0.015 inch (Fig. 23). With the expander type rings the clearance between the rings and ring groove should not be less than 0.0015 inch nor more than 0.0020 inch, and if the gap is more than 0.015 inch when the rings are positioned in the cylinder the rings should be replaced. Gap clearance of new rings when installed in the cylinder must not be less than 0.008 inch nor more than 0.010 inch.

s. Wrist Pins. Check fit of wrist pin in piston and connecting rod. Wrist pins must be a light press fit in the piston. If wrist pin is a loose fit in the piston, the wrist pin, piston, or both must be replaced. Check fit of wrist pin in connecting rod bushing by rocking the piston. If excessive clearance is apparent, replace wrist pin bushings in connecting rod. Wrist pin bushings should be reamed after being pressed in place. Discard all used wrist pin lock wires.

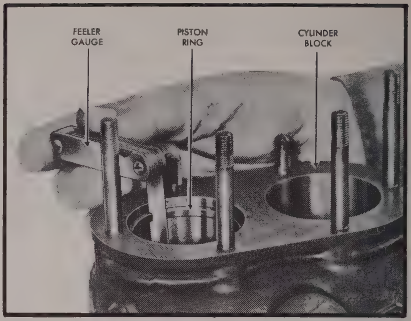


FIG. 23—CHECKING RING GAP CLEARANCE IN CYLINDER

t. Connecting Rod Bearings. Inspect connecting rod bearings for proper fit on crankshaft journals. Also check connecting rod bearing for wear. If worn, cracked, or broken, the babbitt type rod should be rebabbitted or replaced; if the rod has inserted bearings, the inserts should be replaced. Position the cap so that the two locking slots are both located adjacent to the same cap screw. Clearance between the connecting rod journal and the connecting rod bearing must not be less than 0.001 inch and not more than 0.002 inch.

u. Crankshafts. Crankshaft journals which are more than 0.001 inch out-of-round or bruised, must be reground. When regrinding, the fillets at the ends of the journals must be maintained. Connecting rods or bearing inserts are made for standard and 0.010 inch, 0.020 inch, and 0.030 inch undersize reground crankshafts. Screw threads, keyways, tapered ends and all ground and machined surfaces of the crankshaft must not be mutilated or excessively worn. Main bearing journals must not be worn sufficiently to prevent the ball bearings being a light press fit. The width of the splines on crankshafts must not be less than 0.171 inch for those having 10 splines nor less than 0.246 inch for those having 6 splines. The oil seal ring groove in crankshafts fitted with oil seal rings must not be worn to prevent a good fit of the oil seal ring. Clearance between side of the oil seal ring and ring groove should be between 0.0015 inch minimum and 0.0025 inch maximum. Walls of the oil seal ring grooves must be square and have a good finish.

v. Ball Bearings. Check for wear or flat spots and if found, the bearings must be replaced.

Section VII . . . . REPAIRS

Tools referred to by number in this section are illustrated in Figs. 36, 37, 38, 39 and 40.

UNLOADING VALVES

a. Grind unloading valves which are not too badly worn or pitted to their seats using (grade 1000) grinding compound, reciprocating valve grinding tool (202812) and drive tool (230197) (Fig. 24). If the valve seats are badly pitted or worn, they must be reamed using special reamers (Fig. 25). Use reamer (213606 for 3/16 inch or 232020 for ¼ inch inside diameter bushing) for 7¼ ft. two cylinder compressors. Use reamer (213778) for 12 ft. three cylinder compressors. Valves must be ground to their seats and cleaned after reaming. After grinding, install the unloading valves, unloading valve springs, spring seats and retaining washers in the cylinder head (Fig. 26) and test the unloading valves for leakage (Fig. 27).

b. Test the unloading valves for leakage by clamping the cylinder head in a special fixture (Figs. 38, 39, or 40). Test with 100 pounds air pressure using soap suds.

c. Each two cylinder compressor unloading valve must be tested by applying soap suds to the exhaust port of the fixture while holding the other unloading valve down off its seat.

d. Each three cylinder compressor unloading valve must be tested by applying soap suds to the exhaust port of the fixture while holding the other two unloading valves down off their seats.

e. Leakage in excess of a one inch soap bubble in three seconds for any one unloading valve is not permissible. If excessive leakage is found, again grind the leaking unloading valve to its seat.

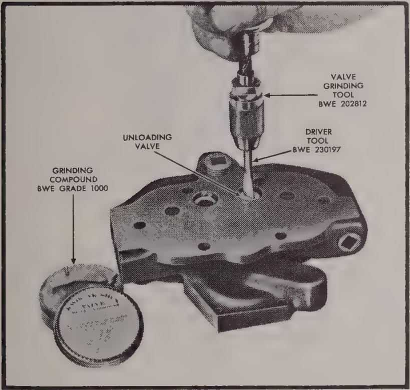

VALVE GRINDING TOOL BWE 202812
DRIVER TOOL BWE 230197
UNLOADING VALVE
GRINDING COMPOUND BWE GRADE 1000

FIG. 24—GRINDING UNLOADING VALVES

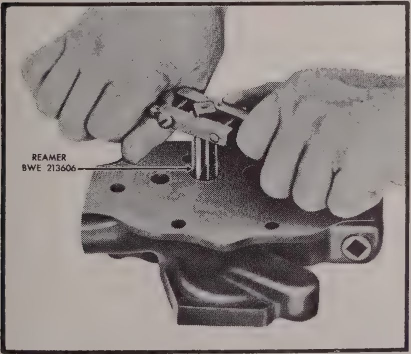

REAMER BWE 213606

FIG. 25—REAMING UNLOADING VALVE SEATS

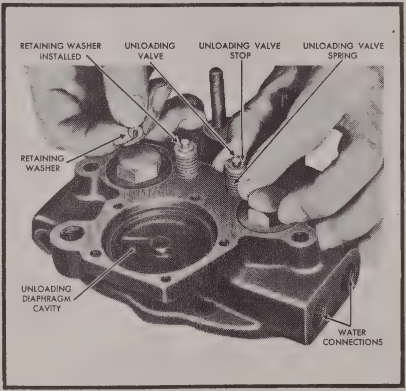

RETAINING WASHER INSTALLED
UNLOADING VALVE
UNLOADING VALVE STOP
UNLOADING VALVE SPRING
RETAINING WASHER
UNLOADING DIAPHRAGM CAVITY
WATER CONNECTIONS

FIG. 26—INSTALLING UNLOADING VALVES

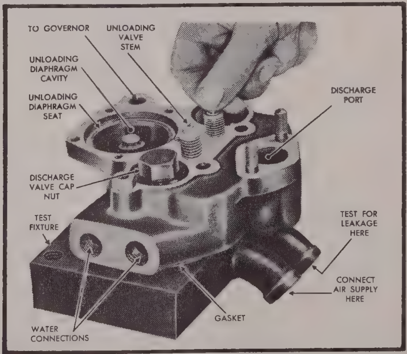

TO GOVERNOR
UNLOADING VALVE STEM
UNLOADING DIAPHRAGM CAVITY
UNLOADING DIAPHRAGM SEAT
DISCHARGE PORT
DISCHARGE VALVE CAP NUT
TEST FIXTURE
TEST FOR LEAKAGE HERE
CONNECT AIR SUPPLY HERE
GASKET
WATER CONNECTIONS

FIG. 27—TESTING UNLOADING VALVES FOR LEAKAGE

DISCHARGE VALVES

a. If the discharge valve seats merely show signs of slight scratches, they can be reclaimed by using grinding compound (grade 1000), lapping disc (230194), grinding tool (202812), and driver (230197) (Figs. 36 and 37).

b. If the valve seats are pitted, use lapping stone (221622), driver (230197) and grinding tool (202812) before using lapping disc (230194) and (grade 1000) grinding compound.

c. If the valve seats are badly pitted or scratched, use reamer (221614) (Fig. 28) before using lapping stone (221622) or lapping disc (230194).

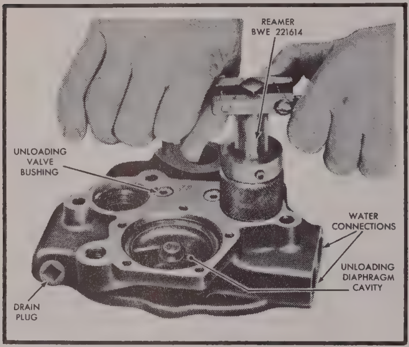

REAMER
BWE 221614
UNLOADING
VALVE
BUSHING
WATER
CONNECTIONS
UNLOADING
DIAPHRAGM
CAVITY
DRAIN
PLUG

FIG. 28—REAMING DISCHARGE VALVE SEATS

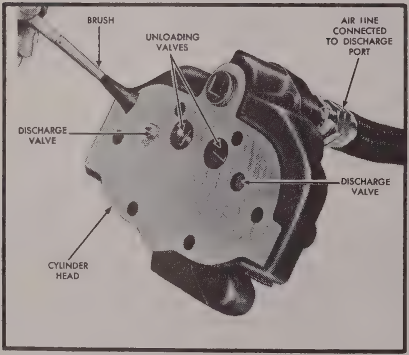

BRUSH
UNLOADING
VALVES
AIR LINE
CONNECTED
TO DISCHARGE
PORT
DISCHARGE
VALVE
DISCHARGE
VALVE
CYLINDER
HEAD

FIG. 29—TESTING DISCHARGE VALVES FOR LEAKAGE

d. After the discharge valves, discharge valve springs, and cap nuts are installed, the discharge valves must be tested for leakage.

e. To test for leakage, apply 100 pounds air pressure through the discharge port of the cylinder head and apply soap suds to the discharge valve openings (Fig. 29). Leakage in excess of a one inch soap bubble in one second is not permissible.

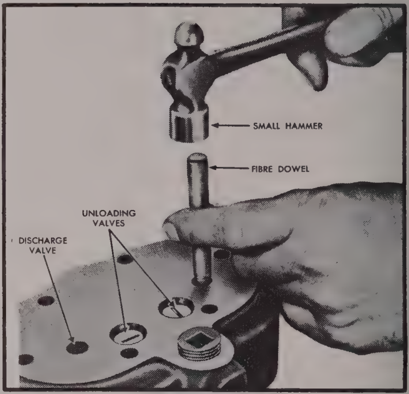

SMALL HAMMER
FIBRE DOWEL
UNLOADING
VALVES
DISCHARGE
VALVE

FIG. 30—SEATING DISCHARGE VALVES WITH DOWEL

f. If excessive leakage is found, leave the air pressure applied and using a fiber or hardwood dowel and light hammer, tap the discharge valves off their seats several times to improve the seal between the valve and its seat. If the valves and valve seats have been reconditioned correctly, this will reduce the leakage.

g. Leakage tests must also be made by applying soap suds around the top of the discharge valve cap nuts and leakage here must not exceed a one inch soap bubble in five seconds.

OIL PUMP RELIEF VALVE

a. Assemble oil pump relief valve (Fig. 5) and check its operation by applying air pressure to assembly. Threads for attaching oil pump relief valve assembly to base plate are 9/16-18 SAE. Oil pump relief valve piston must rise sufficiently to begin to uncover the ports in the side of the body when air pressure is between 14 pounds minimum and 24 pounds maximum. If oil pump relief valve operation is correct, prick punch the spring retaining pin and body to lock the pin in place.

Section VIII . . . . ASSEMBLY

INSTALLING CYLINDER BLOCKS.......................... 1
INSTALLING CRANKSHAFTS............................ 2
ASSEMBLING PISTONS AND CONNECTING RODS........ 3
INSTALLING PISTONS AND CONNECTING RODS......... 4
ASSEMBLING AND INSTALLING CYLINDER HEADS...... 5
ASSEMBLING AND INSTALLING BASE PLATES.......... 6
ASSEMBLING AND INSTALLING AIR STRAINERS......... 7
INSPECTION OF REBUILT UNIT.......................... 8

1. INSTALLING CYLINDER BLOCKS

a. Place new cylinder block gasket in position over crankcase studs. Position cylinder block on crankcase in accordance with markings made before disassembly. Install nuts and lock washers securing cylinder block to crankcase.

2. INSTALLING CRANKSHAFTS

If the crankshaft is fitted with oil seal rings, install rings.

b. Position ball bearings and crankshaft in crankcase being sure the drive end of the crankshaft is positioned at the end of the crankcase marked with one punch mark before disassembly. If one end of the crankcase is counter-bored for holding bearing, be sure the crankshaft is entered through the correct end of the crankcase. Press crankshaft and bearings into crankcase (Fig. 31).

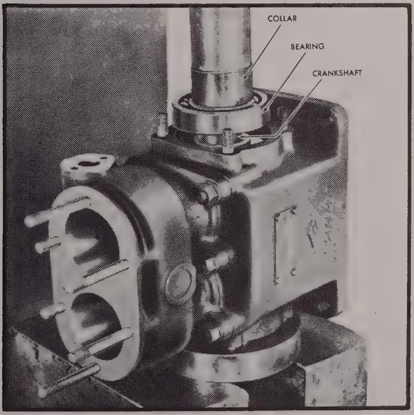


FIG. 31—INSTALLING CRANKSHAFT AND BEARINGS USING ARBOR PRESS

c. If compressor assembly includes a special lock washer and lock nut at either or both ends of the crankshaft, install lock washers and lock nuts and tighten lock nuts. Then bend one lug on each lock washer into one of the slots in each lock nut to prevent lock nut from coming loose. (The use of these lock nuts and lock washers in vertical types of compressors has been discontinued and they may be omitted if desirable).

d. Place a new rear end cover gasket in position over studs on rear end of crankcase being sure the oil hole in the gasket lines up with the oil hole in the crankcase.

e. If rear end cover includes an oil seal ring, install oil seal ring. Then position rear end cover over studs in crankcase being sure that the oil hole in the rear end cover lines up with oil hole in the gasket and crankcase. Install nuts and lock washers securing end cover in place. Install pipe plugs in any oil openings in end cover.

f. If front end cover includes an oil seal and the oil seal has been removed from the end cover, press a new oil seal into end cover. Install a new gasket. Carefully position the front end cover so as not to damage the oil seal and install nuts and lock washers securing end cover in place.

3. ASSEMBLING PISTONS AND CONNECTING RODS

a. If wrist pin bushings have been removed from connecting rods, press new bushings into place making sure that the oil holes in the bushings line up with the oil holes in the connecting rods. Bushings must then be reamed, honed, or bored to provide between 0.0005 inch and 0.001 inch clearance on the wrist pin. Position connecting rod in piston and press wrist pin into piston with lock wire hole in pin aligned with lock wire hole in piston. Install new wrist pin lock wire in wrist pin so that the end of the wire engages the hole in the piston. Do not use pistons in which the wrist pin is loose.

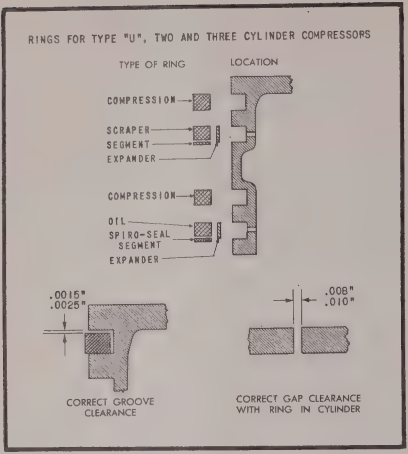


FIG. 32—POSITION OF PISTON RINGS

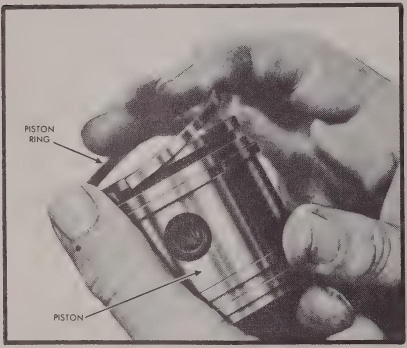


FIG. 33—INSTALLING PISTON RINGS

b. Install piston rings by hand (Fig. 33). Four rings are used in each piston and they must be installed in their proper location (Fig. 32). Careful inspection is necessary to determine which side of the tapered oil ring used in two cylinder compressors has the largest diameter. Tapered oil rings are marked with a small diamond shaped trademark on the top side of the ring opposite the gap and must be installed with the trademark side of the ring toward the top of the piston. Compression rings for two cylinder compressors are marked with a small diamond shaped trademark near the gap in the ring and can be installed with either side toward the top of the piston. Piston rings for three cylinder compressors are easily identified by their shape so the compression rings and oil scraper rings may be installed with the proper side uppermost. Ventilated oil rings are installed with either side uppermost. The location and correct positioning of all piston rings as shown in Fig. 32 is very important. Stagger the position of the ring gaps.

4. INSTALLING PISTONS AND CONNECTING RODS

a. Before installing pistons and connecting rods, thoroughly lubricate pistons, piston rings, wrist pin bearings, and connecting rod bearings with clean engine oil.

b. Turn crankshaft so as to position No. 1 crankshaft journal downward. Remove bearing cap from No. 1 connecting rod leaving connecting rod bolts in the rod.

c. Insert No. 1 connecting rod and piston through top of No. 1 cylinder being sure the connecting rod bearing engages the connecting rod journal in the same position as that in which it was fitted.

d. Position and attach lower bearing cap to connecting rod and install two castellated nuts and cotter pins.

e. Install other pistons and connecting rods in the same manner.

5. ASSEMBLING AND INSTALLING CYLINDER HEADS

a. If the unloading valve bushings have been removed, press new bushings into place. Unloading valve bushings in two cylinder compressors must be pressed in from the top of the cylinder head. Unloading valve bushings in three cylinder compressors must be pressed in from the bottom of the cylinder head. Unloading valve bushings must be reamed after being pressed into place (Fig. 25).

b. Insert each unloading valve into cylinder head body from bottom side. Place small wooden block or a nut under valve to keep it in position. Then install unloading valve spring over each unloading valve and place unloading valve stop over each spring. Then compress each unloading valve spring by hand until spring retainer washer can be inserted over stop (Fig. 26).

c. Position each discharge valve on its seat through the opening in the top of the cylinder head (Fig. 34). Then position discharge valve spring and discharge valve cap nut by inserting them into cylinder head body over discharge valve. Tighten each discharge valve cap nut.

d. Position two unloading diaphragms in opening in top of cylinder head body after lubricating the diaphragms with a thin coating of light engine oil. Place diaphragm follower in position on diaphragms with post upward. Place unloading box cover in position over diaphragm follower post. Attach unloading box cover to cylinder head body with machine screws and lock washers. Tighten all machine screws gradually and evenly.

e. Check for leakage past the unloading diaphragms by applying one hundred pounds air pressure through the unloading diaphragm cavity port and applying soap suds all over the unloading box cover. Leakage in excess of a one inch soap bubble in three seconds is not permissible.

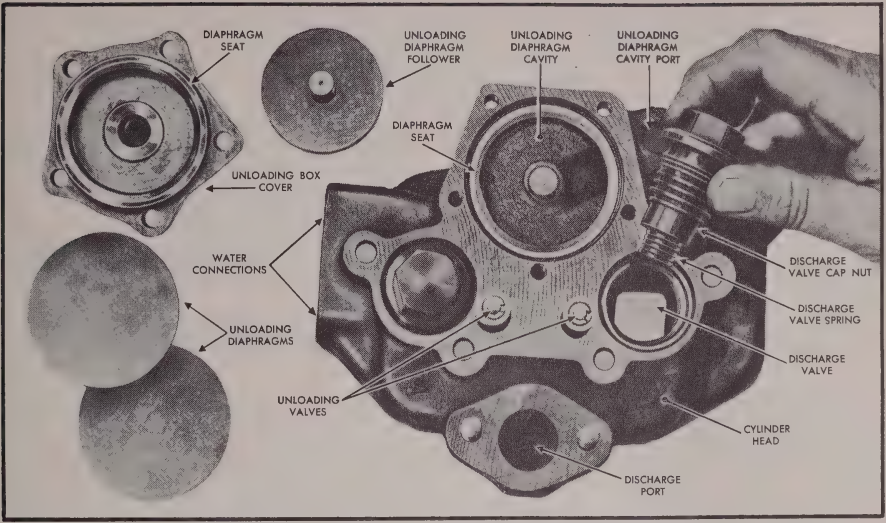

DIAPHRAGM SEAT
UNLOADING DIAPHRAGM FOLLOWER
UNLOADING DIAPHRAGM CAVITY
UNLOADING DIAPHRAGM CAVITY PORT
DIAPHRAGM SEAT
UNLOADING BOX COVER
WATER CONNECTIONS
DISCHARGE VALVE CAP NUT
DISCHARGE VALVE SPRING
UNLOADING DIAPHRAGMS
DISCHARGE VALVE
UNLOADING VALVES
CYLINDER HEAD
DISCHARGE PORT

FIG. 34—INSTALLING DISCHARGE VALVES

f. Place dust guard in position on unloading box cover.

g. Place unloading lever spring in position on unloading box cover and position unloading lever over spring. Insert unloading lever pin through unloading box cover and unloading lever. Install cotter pins in the ends of unloading lever pin.

h. Turn adjusting screws in unloading lever until clearance between the head of the adjusting screws and the end of the unloading valves is 0.010 inch minimum, 0.015 inch maximum (Fig. 15). Tighten lock nuts when desired clearance is obtained. If there is too much clearance at this point, the unloading valves may not be opened sufficiently to unload the compressor. If there is no clearance, the unloading valves may be held open continuously and the compressor will not compress air.

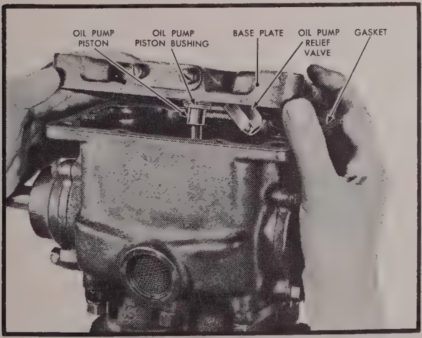

OIL PUMP PISTON
OIL PUMP PISTON BUSHING
BASE PLATE
OIL PUMP RELIEF VALVE
GASKET

FIG. 35—POSITIONING OIL PUMP PISTON AND INSTALLING BASE PLATE OF SELF-LUBRICATED COMPRESSORS

i. Install a new cylinder head gasket so the cutaway portions of the gasket will line up with the unloading valves when the cylinder head is in position.

j. Position cylinder head on cylinder block in accordance with markings made before disassembly and install and tighten nuts on cylinder head studs.

6. ASSEMBLING AND INSTALLING BASE PLATES (SELF LUBRICATED COMPRESSORS ONLY)

a. Install oil pump piston and rod on crankshaft. Oil pump rod bearing fit must be the same as specified for connecting rod bearings. Be sure to install cotter pins in nuts attaching bearing cap.

b. Install oil pump relief valve in compressor base plate and tighten securely.

c. Position oil pump screen in base plate and install retaining ring.

d. Install oil filler drain fitting and blanking cover on sides of base plate, if they have been removed, being sure the oil filler fitting is positioned as marked before disassembly.

e. Install a new oil pump check valve gasket in bottom of crankcase and position a new base plate gasket on bottom of crankcase.

f. Position base plate assembly on bottom of the crankcase being sure the oil pump piston engages the oil pump bushing in the base plate (Fig. 35) and install dowel screw at end of base plate. Install remaining attaching machine screws and tighten securely.

7. ASSEMBLING AND INSTALLING AIR STRAINERS

a. If the compressor assembly includes an air strainer, assemble air strainer (Fig. 14). Using a new gasket, position and install strainer on cylinder block as marked before disassembly. Install inlet chamber blanking covers and new gaskets on remaining openings in intake manifold.

8. INSPECTION OF REBUILT UNIT

a. Check to be sure all threaded openings to oil passages such as may be found in the end covers or base plate are properly plugged.

b. If the compressor is not to be immediately installed on a vehicle, plug the air connection to the unloading mechanism and the water connections to the cylinder head. Protect the discharge port against the entrance of dirt by fitting it with a temporary blanking cover.

c. Fit the ends of all crankshafts with cotter pins, nuts and keys when such parts are required and then protect against damage during handling by wrapping with friction tape or some other similar material.

d. The unloading lever and valve mechanism must be well lubricated with lubricating oil.

e. Protect the open bottom of engine-lubricated compressors against the entrance of dirt during handling or storage by installing a temporary wooden cover.

Section IX . . . . TESTING REBUILT COMPRESSORS

In order to properly test compressors under operating conditions considerable equipment is necessary for mounting, lubricating, and driving the compressor during the tests. Such tests are not compulsory provided the unit has been carefully rebuilt by an experienced mechanic.

If facilities for making such tests are available, the crankcase of all self-lubricated compressors must be properly filled with lubricating oil before the compressor is run. Engine-lubricated compressors must be connected to an oil supply line of at least 15 pounds pressure during all tests and facilities must be provided for keeping the compressor crankcase free of oil during the tests. Water-cooled compressors must be connected to a water circulating system during test runs.

The following tests are recommended.

(1) A run in test is made by running the compressor at 1250 rpm for one half hour with the discharge port open to atmosphere. Check during this run for oil leaks, overheated bearings and excessive noise.

(2) An oil passing test is made by running the compressor for one half hour at 1250 rpm, pumping against 50 pounds air pressure, with an oil trap connected in the discharge line. The oil passed during this test must not exceed two cubic centimeters.

(3) An efficiency test is made by running the compressor for one half hour at 1250 rpm connected to a reservoir fitted with an orifice type exhaust fitting.

The following table shows the size of the orifice used and the minimum pressure that should be maintained in the reservoir with each size of compressor.

Size of Compressor	Size of Orifice	Minimum Pressure Pounds
4 Cu. ft.	3/64″	44
6 Cu. ft.	1/16″	41
7¼ Cu. ft.	1/16″	47
12 Cu. ft.	5/64″	55

(4) Oil pressure tests on self-lubricated compressors are made by connecting an accurate oil pressure test gage to the compressor lubricating system. With the compressor running at 1250 rpm the oil pressure must not be less than 14 pounds nor more than 24 pounds.

Section X . TROUBLE SHOOTING, TABULATED DATA, and SPECIAL TOOLS

TROUBLE SHOOTING

1. COMPRESSOR FAILS TO MAINTAIN ADEQUATE PRESSURE IN THE AIR BRAKE SYSTEM.

Dirty intake strainer.

Excessive carbon in compressor cylinder head or discharge line.

Discharge valves leaking.

Excessive wear.

Drive belt slipping.

No clearance at compressor unloading valves.

Unloading valves stuck open.

Excessive leakage of unloading valves.

2. NOISY OPERATION.

Back lash in drive coupling or drive gears.

Loose drive pulley.

Excessive carbon in cylinder head or discharge line.

Worn or burnt out bearings.

Excessive wear.

3. COMPRESSOR PASSES EXCESSIVE OIL.

Excessive wear.

Dirty air strainer.

Excessive oil pressure.

Oil return line or passage to engine crankcase plugged.

Compressor crankcase flooded.

Back pressure from engine crankcase.

Oil rings improperly installed.

4. COMPRESSOR DOES NOT UNLOAD.

Defective unloading diaphragms.

Excessive clearance at unloading valves.

Unloading cavity plugged with carbon.

Unloading mechanism binding or stuck.

TABULATED DATA

	Compressor Displacement at 1250 R.P.M.			
	4 Cu. ft.	6 Cu. ft.	7¼ Cu. ft.	12 Cu. ft.
Number of cylinders........................	2	2	2	3
Bore....................................	1-5/8″	1-7/8″	2-1/16″	2-3/16″
Stroke....................................	1-3/8″	1-1/2″	1-1/2″	1-1/2″
Horsepower required at 1250 R.P.M. against 90 pounds air pressure....................	.85	1.3	1.6	2.6
Recommended maximum speed for water-cooled compressors (R.P.M.)......................	2000	2000	2000	2000
Recommended maximum speed for air-cooled compressors (R.P.M.)......................	1250	1250	1250	1250
Minimum oil pressure required at engine idling speed (pounds per square inch).............	5	5	5	5
Minimum oil pressure required at maximum engine governed speed (pounds per square inch)....	15	15	15	15

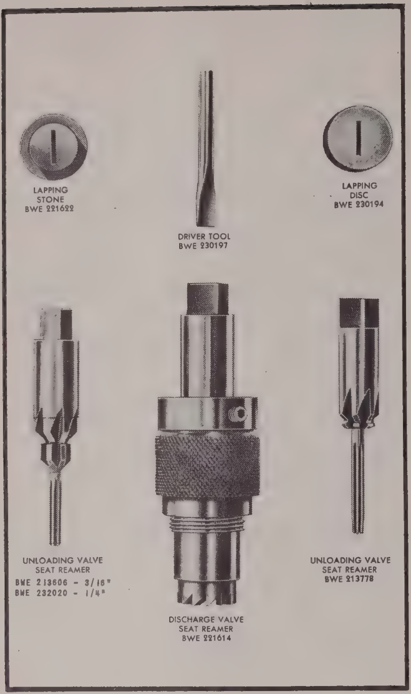

LAPPING STONE BWE 221622
DRIVER TOOL BWE 230197
LAPPING DISC BWE 230194
UNLOADING VALVE SEAT REAMER BWE 213606 - 3/16" BWE 232020 - 1/4"
DISCHARGE VALVE SEAT REAMER BWE 221614
UNLOADING VALVE SEAT REAMER BWE 213778

FIG. 36—SPECIAL TOOLS FOR REPAIRING COMPRESSOR CYLINDER HEADS

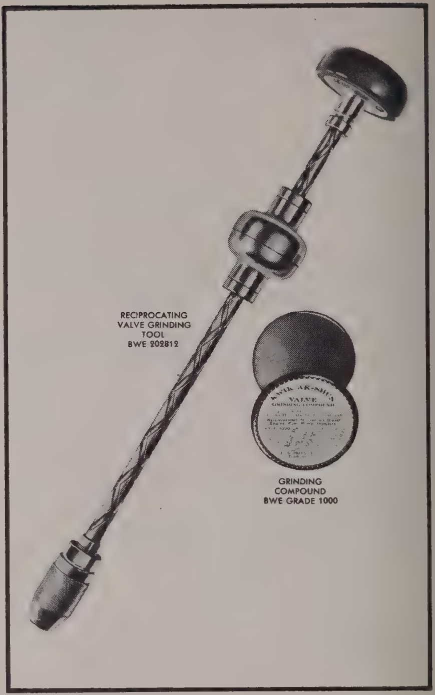

RECIPROCATING VALVE GRINDING TOOL BWE 202812
GRINDING COMPOUND BWE GRADE 1000

FIG. 37—RECIPROCATING VALVE GRINDING TOOL AND SPECIAL VALVE GRINDING COMPOUND

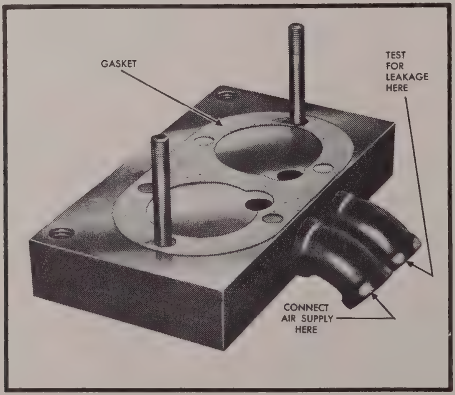

GASKET
TEST FOR LEAKAGE HERE
CONNECT AIR SUPPLY HERE

FIG. 38—FIXTURE FOR TESTING UNLOADING VALVES OF TWO CYLINDER COMPRESSORS

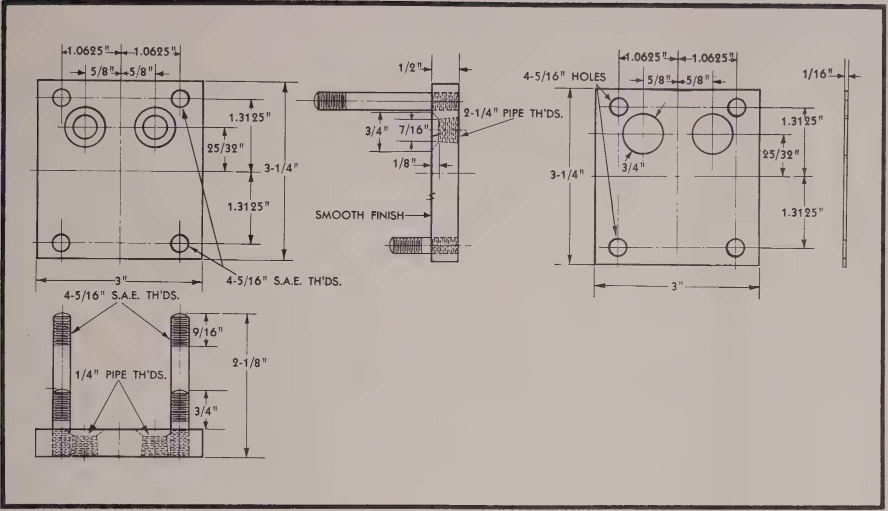

1.0625"
1.0625"
5/8"
5/8"
1.3125"
25/32"
3-1/4"
1.3125"
3"
4-5/16" S.A.E. TH'DS.
1/2"
2-1/4" PIPE TH'DS.
3/4"
7/16"
1/8"
SMOOTH FINISH
4-5/16" HOLES
1.0625"
1.0625"
5/8"
5/8"
1/16"
1.3125"
25/32"
3/4"
3-1/4"
1.3125"
3"
4-5/16" S.A.E. TH'DS.
9/16"
2-1/8"
1/4" PIPE TH'DS.
3/4"

FIG. 39—DRAWING OF FIXTURES FOR TESTING UNLOADING VALVES OF TWO CYLINDER COMPRESSORS

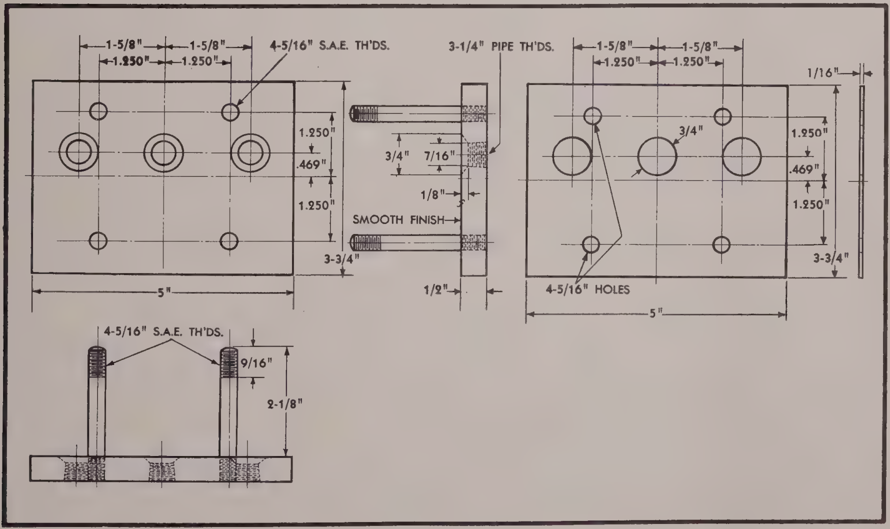

1-5/8"
1-5/8"
1.250"
1.250"
4-5/16" S.A.E. TH'DS.
3-1/4" PIPE TH'DS.
1-5/8"
1-5/8"
1.250"
1.250"
1/16"
1.250"
.469"
1.250"
3-3/4"
5"
3/4"
7/16"
1/8"
SMOOTH FINISH
1/2"
3/4"
1.250"
.469"
1.250"
3-3/4"
4-5/16" HOLES
5"
4-5/16" S.A.E. TH'DS.
9/16"
2-1/8"

FIG. 40—DRAWING OF FIXTURE FOR TESTING UNLOADING VALVES OF THREE CYLINDER COMPRESSORS

SAFETY STANDARD OF THE WORLD

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

Printed in U.S.A.

B-W I-P 5065

TYPE D-1 BRAKE VALVE

Bendix-Westinghouse
AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

INSTRUCTION PAMPHLET
No. 5075
REVISED JUNE, 1949

TYPE D-1 BRAKE VALVE

DESCRIPTION AND OPERATION . . . . Section I
PREVENTIVE MAINTENANCE . . . . . Section II
TESTING FOR SERVICEABILITY . . . . Section III
REMOVING AND INSTALLING . . . . . Section IV
DISASSEMBLY . . . . Section V
CLEANING AND INSPECTION OF PARTS . . . Section VI
REPAIRS . . . . Section VII
ASSEMBLY . . . . Section VIII
TESTING AND ADJUSTING REBUILT BRAKE VALVES . . Section IX

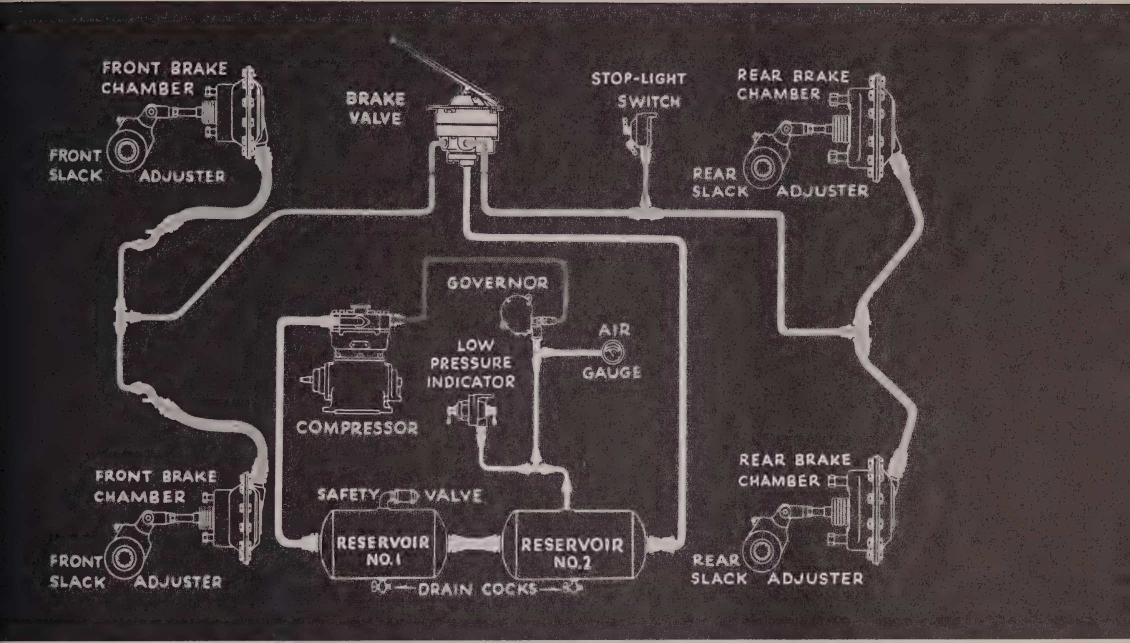

FRONT BRAKE CHAMBER
FRONT SLACK ADJUSTER
BRAKE VALVE
STOP-LIGHT SWITCH
REAR BRAKE CHAMBER
REAR SLACK ADJUSTER
GOVERNOR
AIR GAUGE
LOW PRESSURE INDICATOR
COMPRESSOR
FRONT BRAKE CHAMBER
FRONT SLACK ADJUSTER
SAFETY VALVE
RESERVOIR NO.1
RESERVOIR NO.2
DRAIN COCKS
REAR BRAKE CHAMBER
REAR SLACK ADJUSTER

FIG. 1—PIPING DIAGRAM OF AIR BRAKE SYSTEM WITH TYPE D-1 BRAKE VALVE

Section I . . DESCRIPTION AND OPERATION

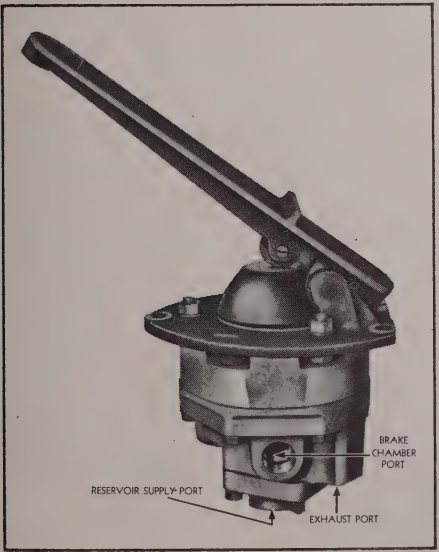

BRAKE CHAMBER PORT
RESERVOIR SUPPLY PORT
EXHAUST PORT

FIG. 2—TYPE D-1 BRAKE VALVE (TREADLE OPERATED)

DESCRIPTION

Type D-1 brake valves have either a foot treadle for operating them or they are fitted with a lever suitable for connecting to a conventional brake pedal. Movement of the treadle or brake pedal controls the movement of an inlet valve and exhaust valve which in turn control the air pressure being delivered to or released from the brake chambers on the vehicle. To fully apply the brakes with a type D-1 brake valve, the treadle (or brake pedal) must be fully depressed; whereas, when the treadle is only partially depressed, correspondingly less braking force is developed. In other words, the farther the driver depresses the treadle, the greater the air pressure delivered to the brake chambers and the more effective the brake application. At any time the brakes of the vehicle may be partially released by the driver permitting the treadle or brake pedal to partially return towards released position or they may be entirely released by permitting the treadle to return to full released position. In this manner the amount of force being applied to the brakes of the vehicle is always under control of the driver.

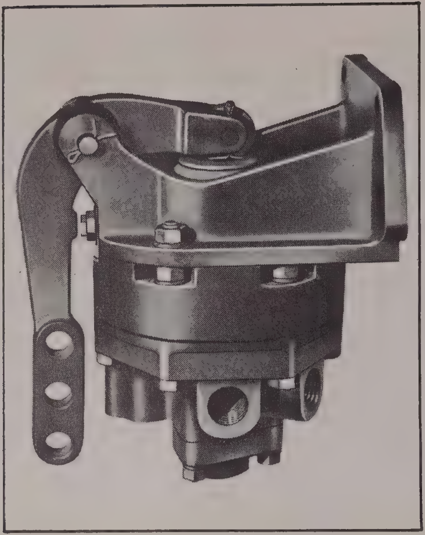


FIG. 3—TYPE D-1 BRAKE VALVE (LEVER OPERATED)

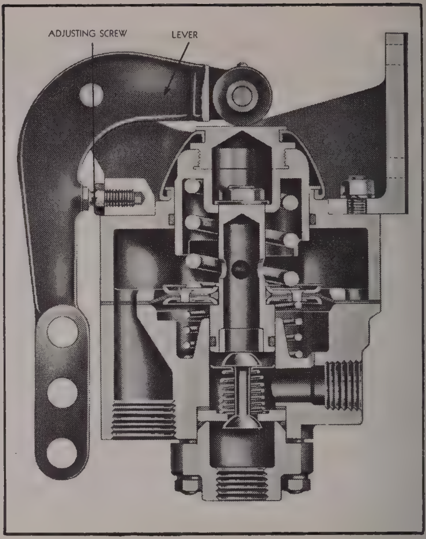

ADJUSTING SCREW
LEVER

FIG. 4—SECTIONAL VIEW OF LEVER TYPE D-1 BRAKE VALVE

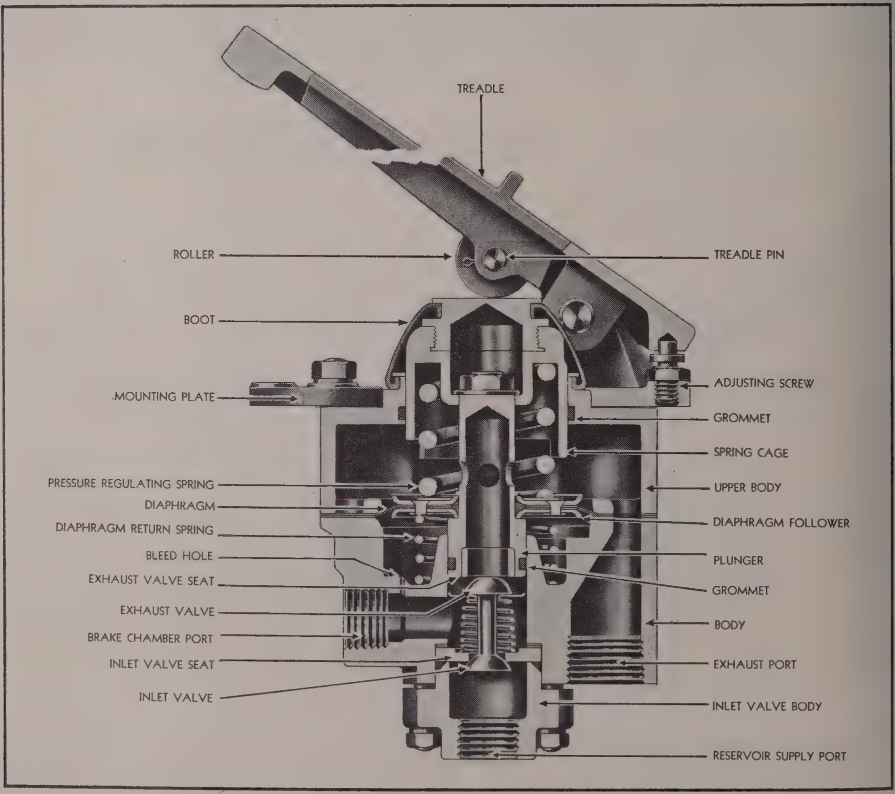

TREADLE
ROLLER
TREADLE PIN
BOOT
MOUNTING PLATE
ADJUSTING SCREW
GROMMET
SPRING CAGE
PRESSURE REGULATING SPRING
UPPER BODY
DIAPHRAGM
DIAPHRAGM FOLLOWER
DIAPHRAGM RETURN SPRING
BLEED HOLE
PLUNGER
EXHAUST VALVE SEAT
GROMMET
EXHAUST VALVE
BODY
BRAKE CHAMBER PORT
INLET VALVE SEAT
EXHAUST PORT
INLET VALVE
INLET VALVE BODY
RESERVOIR SUPPLY PORT

FIG. 5—SECTIONAL VIEW OF TREADLE D-1 TYPE BRAKE VALVE

OPERATION

As the driver depresses the treadle, pressure is exerted on the top of the pressure regulating spring and diaphragm. As the diaphragm moves downward, the exhaust valve seat moves downward against the exhaust valve and closes it. Continued movement of the diaphragm downward pushes the inlet valve off its seat. Air pressure from the reservoir then flows through the inlet valve and out the brake chamber ports to the brake chambers applying the brakes.

When the air pressure being delivered to the brake chambers from the cavity below the diaphragm overcomes the mechanical force being exerted on top of the diaphragm, the diaphragm lifts and the inlet valve closes, cutting off further supply of air pressure to the brake chambers while the exhaust valve remains closed preventing any escape of air pressure through the exhaust port. Should the driver depress the treadle further and put additional force on top of the diaphragm, a corresponding increase in the air pressure being delivered to the brake chambers results.

If the driver permits the treadle to partially return toward its fully released position thus reducing the mechanical force on top of the diaphragm, the air pressure below the diaphragm overcomes the mechanical force on top of it and the diaphragm lifts still further. When this happens, the inlet valve remains closed but the exhaust valve opens to exhaust air pressure from the brake chambers until the air pressure below the diaphragm again balances the mechanical force on top of it. If the driver permits the treadle to return to fully released position, the exhaust valve remains open and all air pressure from the brake chambers is exhausted and the brakes on the vehicle are fully released.

If the driver depresses the treadle to fully applied position, the pressure regulating spring is compressed and the spring cage strikes the diaphragm follower. Under these conditions, the inlet valve is held open permitting full reservoir pressure to pass through the brake valve into the brake chambers.

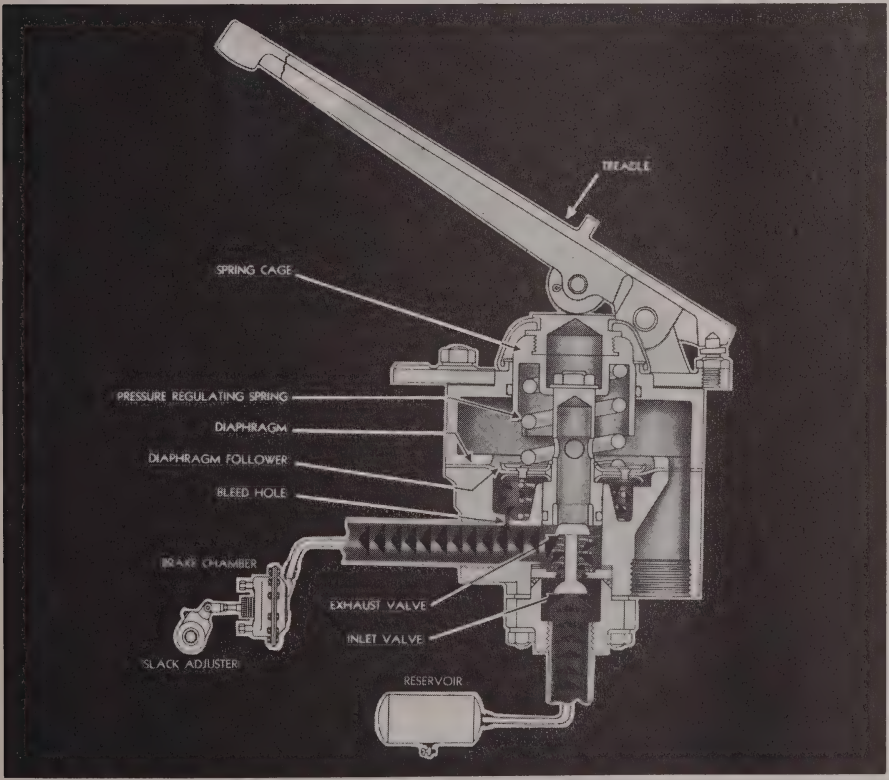


FIG. 6—APPLYING POSITION

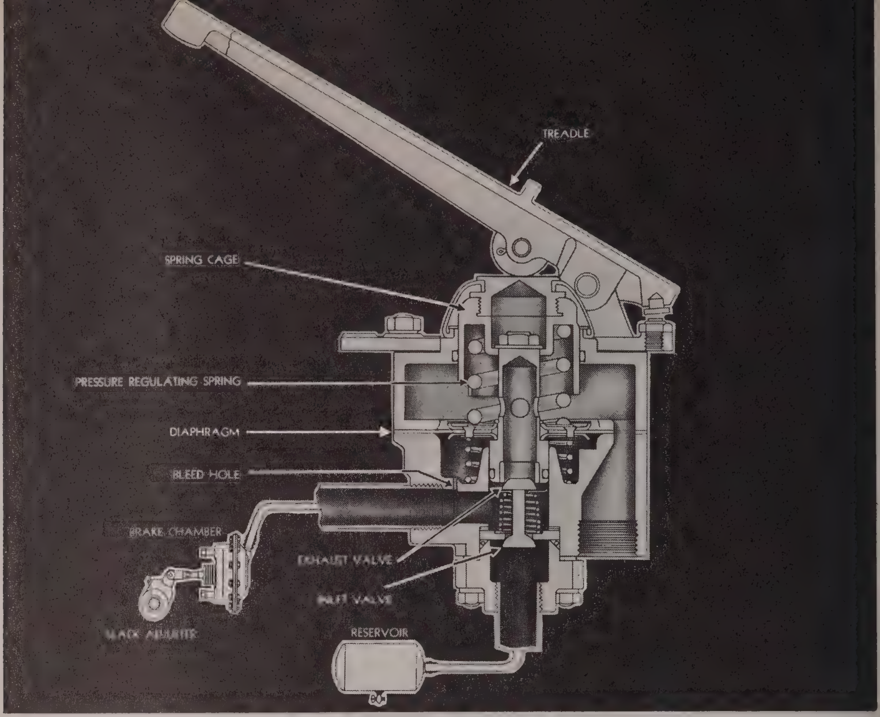

TREADLE
SPRING CAGE
PRESSURE REGULATING SPRING
DIAPHRAGM
BLEED HOLE
BRAKE CHAMBER
EXHAUST VALVE
INLET VALVE
SLACK ADJUSTER
RESERVOIR

FIG. 7—BALANCED POSITION

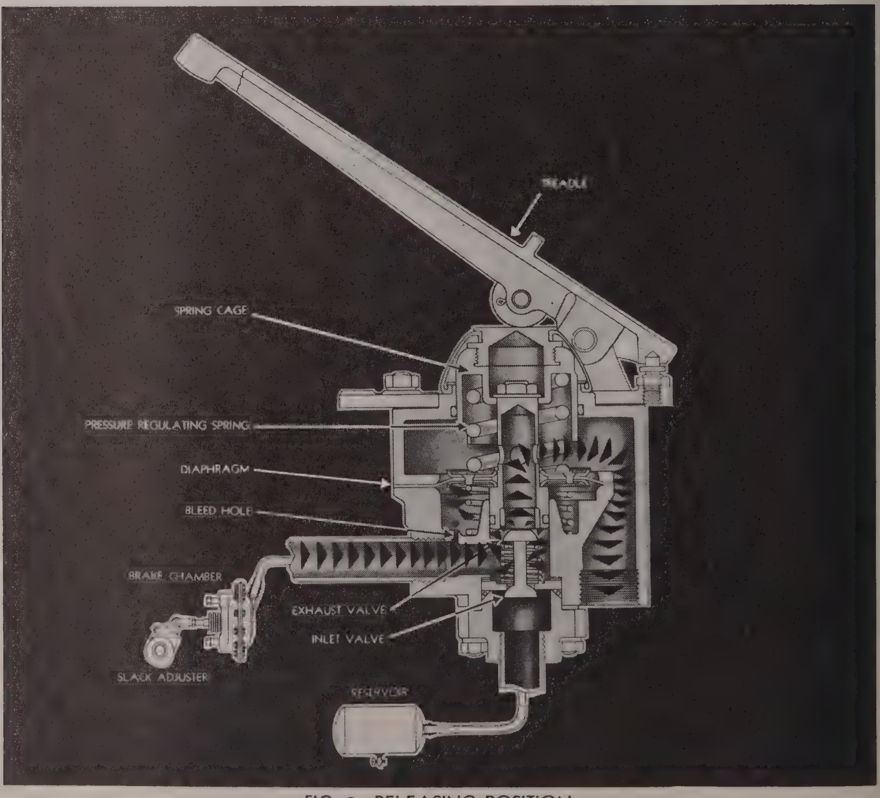

TREADLE
SPRING CAGE
PRESSURE REGULATING SPRING
DIAPHRAGM
BLEED HOLE
BRAKE CHAMBER
EXHAUST VALVE
INLET VALVE
SLACK ADJUSTER
RESERVOIR

FIG. 8—RELEASING POSITION

Section II . . . PREVENTIVE MAINTENANCE

Every month or after each 2,000 miles.

1. Lubricate treadle or lever roller and hinge pin and linkage with lever type valve with engine oil.

2. Lift boot away from upper body and place 3-4 drops SAE 20 engine oil between upper body and spring cage to lubricate grommet. Install boot on upper body.

3. Lever type brake valve only. Check to be sure that with brake fully applied that pedal contacts the floor boards or pedal stop. With brake released check to be sure that the lever arm on the brake valve contacts the adjusting screw on the brake valve. Adjust the pedal stop or linkage, if necessary, to provide for this. After any adjustment, check the brake valve delivery pressure (Section III).

Every 2 years or after each 50,000 miles.

1. Disassemble brake valve and clean all parts (Sections V and VI).

Section III . . TESTING FOR SERVICEABILITY

OPERATING TESTS

1. Check the delivery pressure of brake valve using an accurate air pressure test gage. If the vehicle has trailer connections, the test gage may be conveniently connected to the service line outlet at the rear of the vehicle. With the treadle, or pedal, fully depressed against the treadle, or pedal stop on the floor boards of the vehicle, the brake valve must deliver approximately full reservoir pressure as registered by the dash gage. On some vehicles the treadle, or pedal stop (or linkage) is arranged so as to prevent the brake valve delivering full reservoir pressure. This arrangement must not be altered on such vehicles unless it is necessary to do so in order to correct the maximum delivery pressure. A higher maximum delivery pressure will increase the effectiveness of the brakes.

a. If the lever type brake valve does not deliver approximately full reservoir pressure, when the brake pedal is fully depressed, adjust the pedal stop or linkage so as to increase the travel of the brake valve lever. This should increase the delivered pressure. When making this adjustment make sure that the pedal is stopped, in the maximum applying position, by the pedal striking either a pedal stop or the floor boards. Also make sure that the brake valve lever returns to the fully released position, against the adjusting screw, when the brake pedal is released.

2. Depress the brake pedal to several positions between fully released position and fully applied position and check to be sure the delivered air pressure registered by the test gage varies in accordance with the position in which the treadle is held. The brake valve must control all delivery pressures between approximately 5 and 75 pounds.

LEAKAGE TESTS

1. With the treadle fully released, coat the exhaust port with soap suds to check for leakage.

2. With treadle fully depressed coat the exhaust port with soap suds to check for leakage.

3. Leakage should not exceed a one inch soap bubble in one second in either of these tests. If excessive leakage is found, the brake valve must be repaired or replaced.

Section IV . . . REMOVING AND INSTALLING

If it is necessary to remove or install the brake valve the following procedure will apply:

REMOVING

1. Drain air brake system.

2. Disconnect air lines at brake valve.

3. Remove mounting bolts, and remove brake valve.

INSTALLING

1. Mount brake valve in position.

2. Connect air lines to brake valve.

3. Be sure exhaust port is not plugged.

4. Test brake valve for serviceability (Section III).

Section V . . . . DISASSEMBLY

GENERAL

Remove all dirt and grease from exterior of valve using cleaning solvent and a brush. Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

1. **Mark Before Disassembly.** Mark position of body to upper body with strict attention on position of at least one long cap screw.

2. **Remove and disassemble treadle (or lever).** Remove cotter pin from end of treadle fulcrum pin. Drive out treadle fulcrum pin and remove treadle. If treadle roller is to be removed, remove cotter pin from end of treadle roller pin. Drive out treadle roller pin and remove roller.

3. **Remove mounting plate.** Remove three nuts and lock washers attaching mounting plate to body. Lift off mounting plate.

4. **Remove diaphragm and spring assembly (Fig. 9).**

a. Remove the six bolts, nuts and lock washers attaching upper body to body. Remove upper body. Remove diaphragm and spring assembly from upper body. Remove boot.

b. Remove rubber grommet from upper body.

c. Do not disassemble the pressure regulating spring and diaphragm assembly unless the diaphragm assembly or the exhaust seat have to be replaced. If the diaphragm assembly is disassembled, extreme care must be used to be sure the same shims are replaced and the measurements are maintained.

d. Remove grommet from plunger assembly.

e. Remove diaphragm return spring from body.

5. **Remove inlet and exhaust valve assembly (Fig. 10).**

a. Remove three nuts and lock washers attaching inlet valve body to brake valve body. Remove inlet valve body.

b. Lift rubber grommet, inlet and exhaust valve assembly and shims, out of brake valve body. Do not disassemble the inlet and exhaust valve assembly.

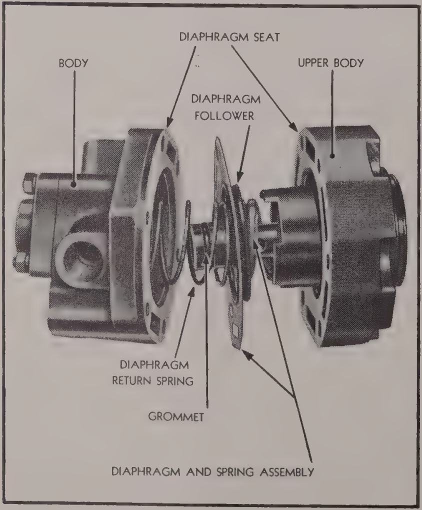

DIAPHRAGM SEAT
BODY
UPPER BODY
DIAPHRAGM FOLLOWER
DIAPHRAGM RETURN SPRING
GROMMET
DIAPHRAGM AND SPRING ASSEMBLY

FIG. 9 —REMOVING UPPER BODY FROM VALVE BODY

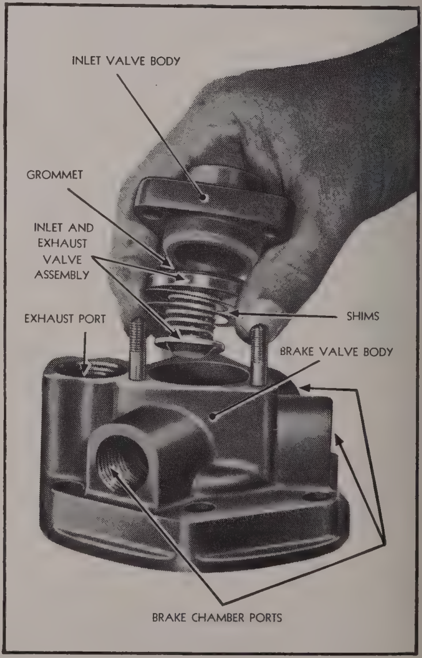

INLET VALVE BODY
GROMMET
INLET AND EXHAUST VALVE ASSEMBLY
EXHAUST PORT
SHIMS
BRAKE VALVE BODY
BRAKE CHAMBER PORTS

FIG. 10 —REMOVING INLET AND EXHAUST VALVE ASSEMBLY

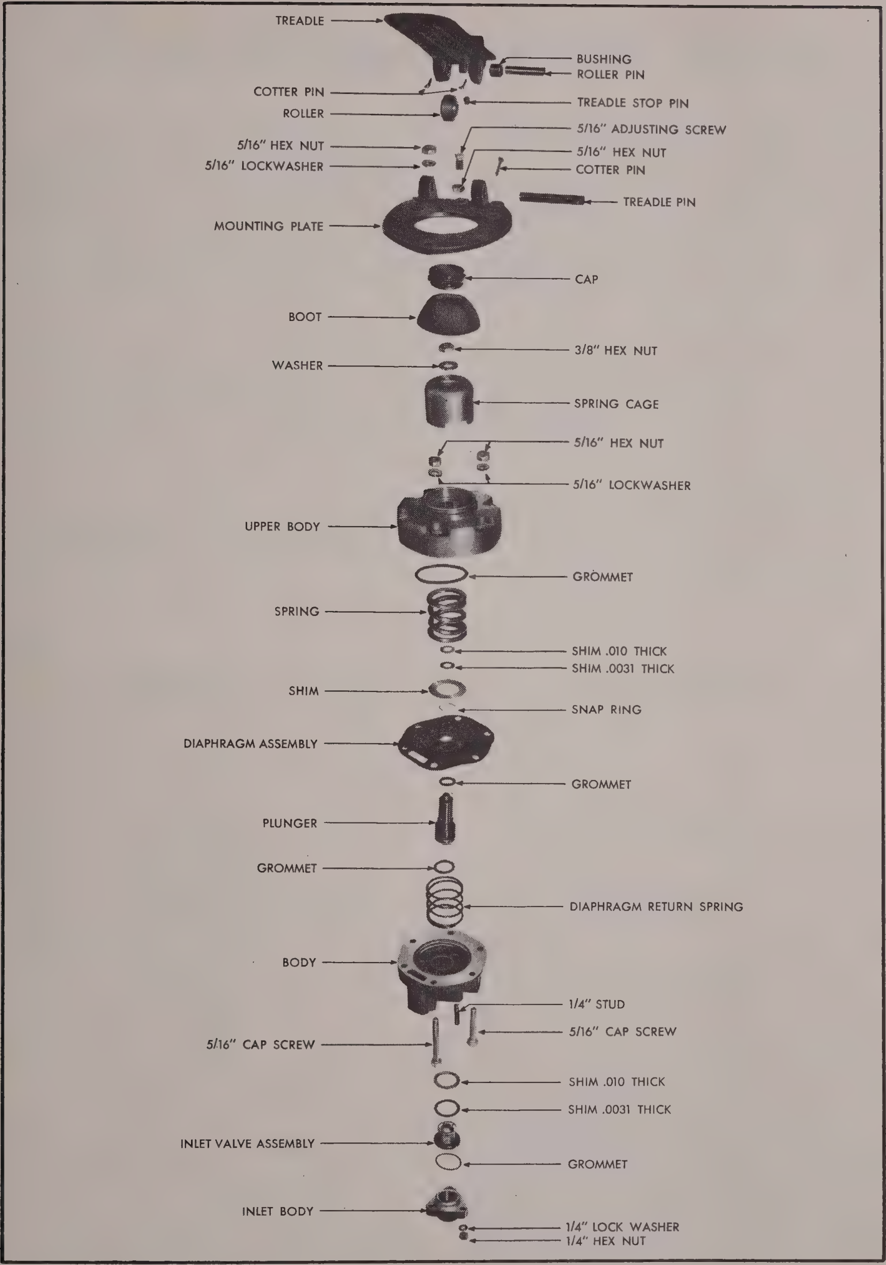

TREADLE
BUSHING
ROLLER PIN
COTTER PIN
TREADLE STOP PIN
ROLLER
5/16" ADJUSTING SCREW
5/16" HEX NUT
5/16" HEX NUT
5/16" LOCKWASHER
COTTER PIN
TREADLE PIN
MOUNTING PLATE
CAP
BOOT
3/8" HEX NUT
WASHER
SPRING CAGE
5/16" HEX NUT
5/16" LOCKWASHER
UPPER BODY
GROMMET
SPRING
SHIM .010 THICK
SHIM .0031 THICK
SHIM
SNAP RING
DIAPHRAGM ASSEMBLY
GROMMET
PLUNGER
GROMMET
DIAPHRAGM RETURN SPRING
BODY
1/4" STUD
5/16" CAP SCREW
5/16" CAP SCREW
SHIM .010 THICK
SHIM .0031 THICK
INLET VALVE ASSEMBLY
GROMMET
INLET BODY
1/4" LOCK WASHER
1/4" HEX NUT

FIG. 11—EXPLODED VIEW OF TREADLE TYPE D-1 BRAKE VALVE

Section VI . CLEANING AND INSPECTION OF PARTS

CLEAN ALL PARTS. Wash all metal parts in cleaning solvent.

PRESSURE REGULATING SPRING AND DIAPHRAGM ASSEMBLY. Carefully inspect both diaphragms to be sure they are not cracked or deteriorated. If cracks or deterioration are found, the diaphragm assembly must be replaced. Inspect condition of exhaust valve seat. If seat is worn excessively or if it is damaged in any way, the plunger or the complete diaphragm and pressure regulating spring assembly must be replaced. If the pressure regulating spring is damaged in any way, it must be replaced.

TREADLE ASSEMBLY. Check fit of treadle fulcrum pin in treadle and mounting plate bushings. Pin must be a neat free fit. If bushings in mounting plate are worn, they must be pressed out and replaced. Inspect treadle roller for fit on roller pin, also for flat spots. Roller must be a free rolling fit on pin. If excessive wear is found or if the roller has any flat spots, the pin, the roller, or both must be replaced. Check to be sure the stop button at the top of the treadle and the stop pin at the heel of the treadle are in place and in good condition. Replace if necessary.

MOUNTING PLATE. Check for cracks or breakage. Replace if necessary. Check adjusting screw and lock nut. If worn or damaged, replace.

BOOT. Replace if cracked or deteriorated.

UPPER BODY. Replace rubber grommet. Check fit of spring cage in upper body. Spring cage must be a neat sliding fit in upper body. Check to be sure the diaphragm follower seat on the bottom of the upper body is not damaged in any way to prevent perfect contact with the diaphragm follower. Inspect diaphragm seat to be sure it is not nicked or damaged in any way to prevent perfect contact with the diaphragm. Check diaphragm seat radius for burrs or nicks. If diaphragm seat is damaged replace upper body.

BODY. Inspect diaphragm seat in top of body. Be sure it is flat and smooth. If the diaphragm seat is damaged in any way, replace body. Inspect small bleed hole leading to brake chamber port in body to be sure it is open and not obstructed. Inspect diaphragm follower seat for excessive wear or damage. Replace body if worn excessively. Place plunger assembly into body, it should be a neat sliding fit.

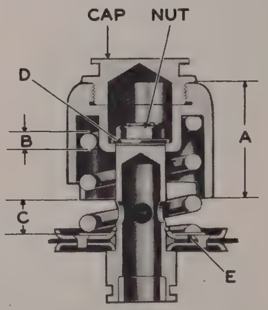
INLET AND EXHAUST VALVE ASSEMBLY. Inspect inlet and exhaust valve assembly for broken spring and worn or damaged valves and seat. If the assembly is damaged or worn excessively, it must be replaced.

Section VII . . . . REPAIRS

PRESSURE REGULATING SPRING AND DIAPHRAGM ASSEMBLY.

a. If it is necessary to replace parts, extreme caution must be used to be sure the same shims are again used in the pressure regulating spring assembly. To disassemble the pressure regulating spring assembly, loosen the cap from the spring cage by clamping the spring cage in a strap wrench or use a special tool to hold the spring cage at the step at the bottom. Be sure not to score or damage the spring cage in any way. Remove the cap. Loosen the nut in the spring cage by holding the plunger with a rod through the exhaust hole in the plunger. Remove nut and flat washer, spring cage, and pressure regulating spring. Remove snap ring which holds the diaphragm assembly in place.

b. Position new grommet in diaphragm assembly. After all parts are positioned, the nut in the spring cage must be screwed down until the nut is tight. Check spring preload per instructions in Fig. 12. Note that spring cage and spring (dimensions A and B) are different in the earlier "Long Travel" valves than in the later "Short Travel" valves. After checking, prick punch the nut. Replace, tighten and prick punch cap in place.



USE SHIMS 'D' TO OBTAIN DIMENSION 'C' THEN USE SHIMS 'E' TO OBTAIN 72 TO 80 POUNDS SPRING PRE-LOAD.

DIMENSION	SHORT TRAVEL	LONG TRAVEL
A	1.905"	1.733"
B	.283"	.250"
C	.387" MIN. .393" MAX.	.559" MIN. .565" MAX.

FIG. 12—PRESSURE REGULATING SPRING AND DIAPHRAGM ASSEMBLY

Section VIII . . . . ASSEMBLY

1. Install new grommet on plunger. Lubricate the plunger grommet, the upper grommet and the surfaces that they slide against with SAE 20 engine oil. Install pressure regulating assembly in body taking special notice that exhaust hole at edge of diaphragm matches exhaust hole in body and that diaphragm return spring is in place. Position upper body on brake valve body so that the prick punch markings, put on before disassembly, match. Place long bolt into the hole for which a marking had been made. Install six bolts, nuts and lock washers attaching cover to body. Place long and short bolts alternately. Tighten securely.

2. Install inlet and exhaust valve assembly. Replace original shims in recess at bottom of body. Install inlet and exhaust valve assembly with spring and exhaust valve uppermost in the body. Position grommet in place against inlet valve seat. Position inlet valve body and install three nuts and lock washers attaching inlet valve body. Tighten evenly and carefully.

3. Install treadle assembly. Position treadle and install treadle fulcrum pin being sure the cotter pin hole in the pin lines with the hole in the treadle, then install cotter pin.

Section IX . . TESTING AND ADJUSTING REBUILT BRAKE VALVES

TESTS

If facilities are available the rebuilt brake valve can be tested on a suitable test rack. If such facilities are not available, the brake valve can be tested on the vehicle.

Both operating tests and leakage tests must be made in either case so the brake valve meets the following specifications:

1. The brake valve must deliver approximately full reservoir pressure when the treadle is fully depressed. If this test is being made on a vehicle and brake valve does not deliver approximately full reservoir pressure check to see if the treadle or pedal stop (or linkage if lever type brake valve is used) is arranged so as to prevent the brake valve from delivering full reservoir pressure. This arrangement, found on some vehicles, must not be altered unless a higher delivery pressure is desired to meet the specification covering the vehicle or unless it is necessary to increase the effectiveness of the brakes.

2. The brake valve must control delivered pressures between approximately 5 and 75 pounds. These pressures must rapidly vary in accordance with the position in which the treadle is held.

3. Leakage at the exhaust port in both the fully applied or fully released positions must not exceed a one inch soap bubble in one second.

4. No leakage is permissible at any other point on the brake valve with the treadle in depressed position.

ADJUSTMENT

If the brake valve does not release promptly, or does not fully release, it indicates that the exhaust valve is not opening sufficiently.

This can be caused by:

1. Improper adjustment of the linkage which would prevent the lever on the lever type valve from returning to the full release position. (See Section III for proper adjustment.)

2. Adjusting screw being screwed out too far causing the roller on the treadle or lever to exert too much force against the spring cage when the brake is released.

3. Insufficient shims being used between the inlet valve seat and the body of the brake valve.

If the brake valve does not apply promptly, or does not apply fully, it indicates that the inlet valve is not opening sufficiently. This can be caused by:

1. Improper adjustment of the treadle or pedal stop, or linkage, which would not permit the spring cage to travel far enough when the brake is being applied. (See Section III for proper adjustment.)

2. Too many shims being used between the inlet valve seat and the body of the brake valve.

Adjustment of the brake valve to obtain correct inlet and exhaust valve opening is as follows:

1. Check to be sure inlet valve is seated.

2. Place a depth gauge against the inlet valve by inserting the gauge through the reservoir supply port in the inlet valve body.

3. Apply the brake valve and measure the maximum inlet valve travel. The travel should be 0.148 inch minimum to 0.156 inch maximum. Add shims between the inlet valve seat and the body of the brake valve to decrease the travel. Remove shims to increase the travel. Adding shims increases the exhaust valve opening, when the brake is released, and decreases inlet valve opening when the brake is being applied. Removing shims decreases the exhaust valve opening, when the brake is released, and increases the inlet valve opening when the brake is being applied.

4. Insert a .109 inch gauge between the treadle (or lever) roller and the cap on the spring cage and turn the adjusting screw until the valve delivers 2-7 pounds air pressure; then lock the adjusting screw.

If the brake valve does not graduate the delivered pressure properly, check to be sure bleed hole to the cavity immediately below the diaphragm is not restricted.

BENDIX-WESTINGHOUSE
GENUINE
AIR BRAKES

SAFETY STANDARD OF THE WORLD

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

Printed in U. S. A.
B-W. I-P 5075

TYPE O-1 GOVERNOR

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

INSTRUCTION PAMPHLET

No. 5066

REVISED MARCH, 1951

, BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY

TYPE 0-1 GOVERNOR

Section I . . . DESCRIPTION and OPERATION

Section II . . . . PREVENTIVE MAINTENANCE

Section III . . TESTING FOR SERVICEABILITY

Section IV . . . REMOVING and INSTALLING

Section V . . . . DISASSEMBLY

Section VI . . . CLEANING and INSPECTION OF PARTS

Section VII . . . . REPAIRS

Section VIII . . . . ASSEMBLY

Section IX . . . TEST and ADJUSTMENT OF REBUILT GOVERNOR

Section X . . . . SPECIAL TOOLS

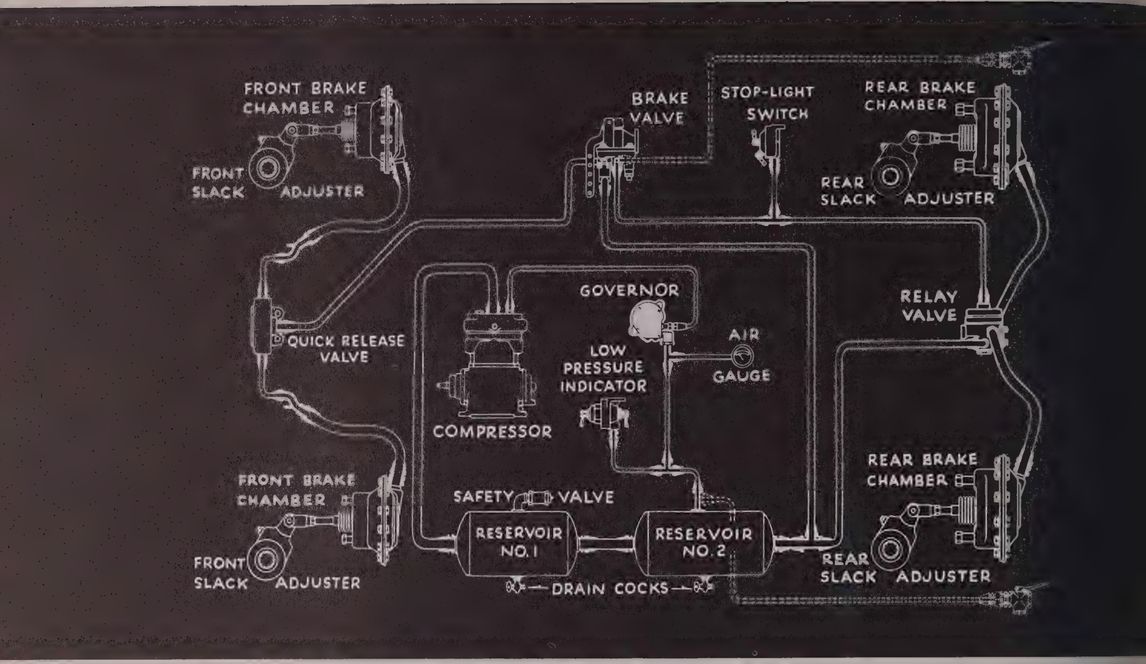

FRONT BRAKE CHAMBER
FRONT SLACK ADJUSTER
BRAKE VALVE
STOP-LIGHT SWITCH
REAR BRAKE CHAMBER
REAR SLACK ADJUSTER
GOVERNOR
RELAY VALVE
QUICK RELEASE VALVE
LOW PRESSURE INDICATOR
AIR GAUGE
COMPRESSOR
FRONT BRAKE CHAMBER
REAR BRAKE CHAMBER
SAFETY VALVE
RESERVOIR NO. 1
RESERVOIR NO. 2
FRONT SLACK ADJUSTER
REAR SLACK ADJUSTER
DRAIN COCKS

FIG. 1—PIPING DIAGRAM OF TYPE O-1 GOVERNOR

Section I . . . DESCRIPTION and OPERATION

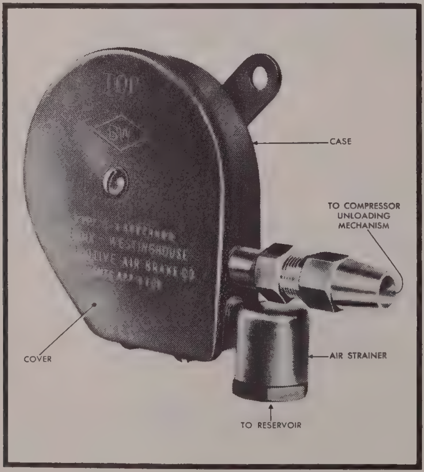

CASE
TO COMPRESSOR UNLOADING MECHANISM
COVER
AIR STRAINER
TO RESERVOIR

FIG. 2—TYPE O-1 GOVERNOR

DESCRIPTION

The purpose of the compressor governor is to automatically control the air pressure being maintained in the reservoirs of the air brake system by the compressor, between the maximum pressure desired (100-105 lbs.) and the minimum pressure required for safe brake operation (80-85 lbs.). To understand this function of the governor, it should be remembered that while the compressor may run continuously, actual compression of air is controlled by the governor, which, acting in conjunction with the compressor unloading mechanism, stops or starts compression when these maximum and minimum reservoir pressures are reached.

The design of the compressor governor is based on the principle of a Bourdon tube which is a flattened metal tube bent to a curve that tends to straighten under internal pressure. This reaction by the tube, due to changes in the air pressure in the tube, increases or decreases the spring load on the valve mechanism of the governor and makes the valve mechanism assume its "cut in" or "cut out" positions in accordance with the air pressure in the reservoir. Two types of governor cases will be found in service, one being a die cast case and the other a pressed steel case. Both types of cases are interchangeable with each other and the working parts of the governor used in both types of cases are identical.

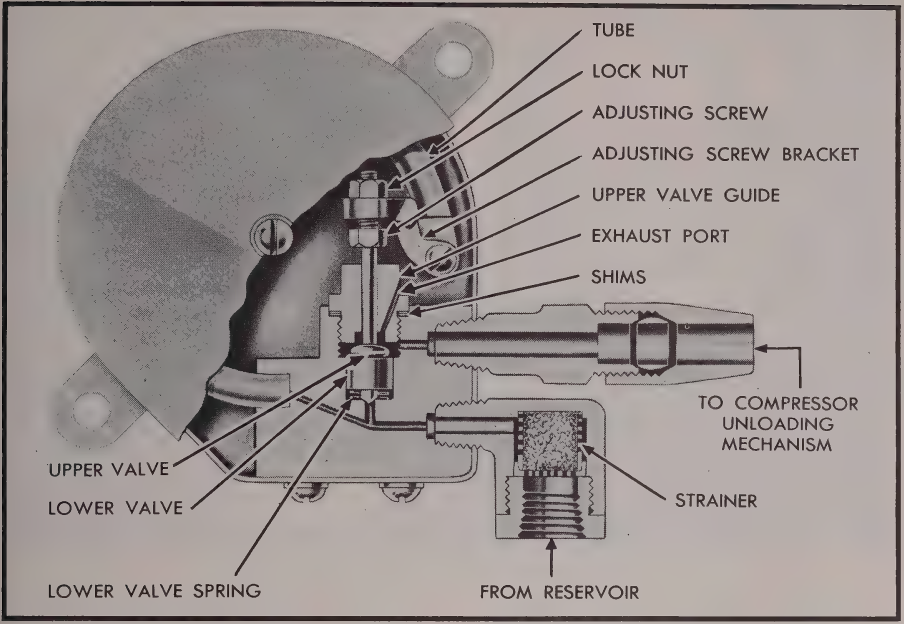

TUBE
LOCK NUT
ADJUSTING SCREW
ADJUSTING SCREW BRACKET
UPPER VALVE GUIDE
EXHAUST PORT
SHIMS
TO COMPRESSOR UNLOADING MECHANISM
STRAINER
UPPER VALVE
LOWER VALVE
LOWER VALVE SPRING
FROM RESERVOIR

FIG. 3—SECTIONAL VIEW OF TYPE O-1 GOVERNOR

OPERATION

Air pressure from the reservoir enters the governor through the strainer and is always present below the lower valve and in the spring tube. As the air pressure increases, the load exerted on the lower valve by the spring tube, decreases because the spring tube tends to straighten out.

When the reservoir air pressure reaches the cut out setting of the governor (100-105 lbs.) the spring load of the spring tube on the upper and lower valves has been reduced enough to permit air pressure to raise the lower valve off its seat. This movement of the lower valve raises the upper valve to its seat which closes the exhaust port. Air then flows up through the small hole in the lower valve and out the upper

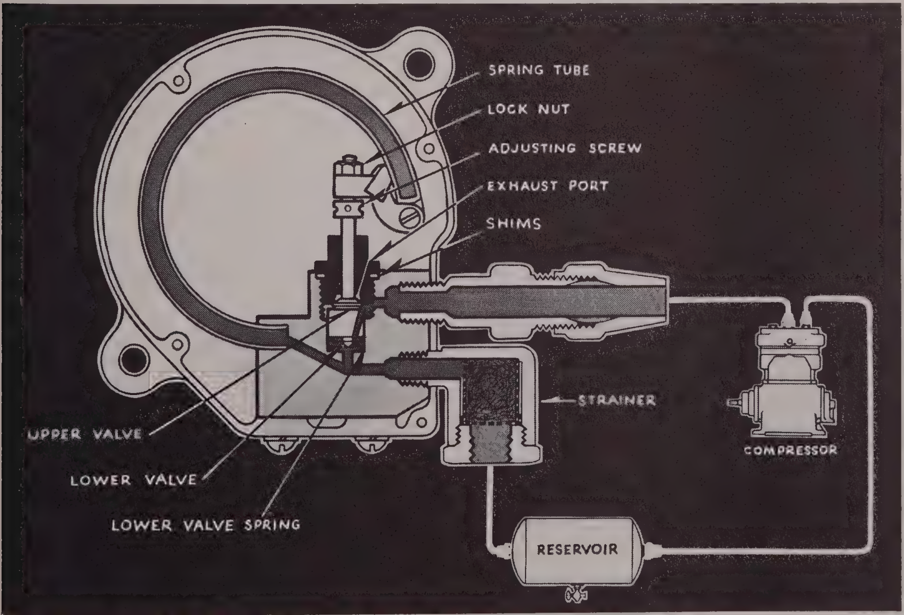

SPRING TUBE
LOCK NUT
ADJUSTING SCREW
EXHAUST PORT
SHIMS
STRAINER
COMPRESSOR
UPPER VALVE
LOWER VALVE
LOWER VALVE SPRING
RESERVOIR

FIG. 4—CUT OUT POSITION (COMPRESSOR NOT OPERATING)

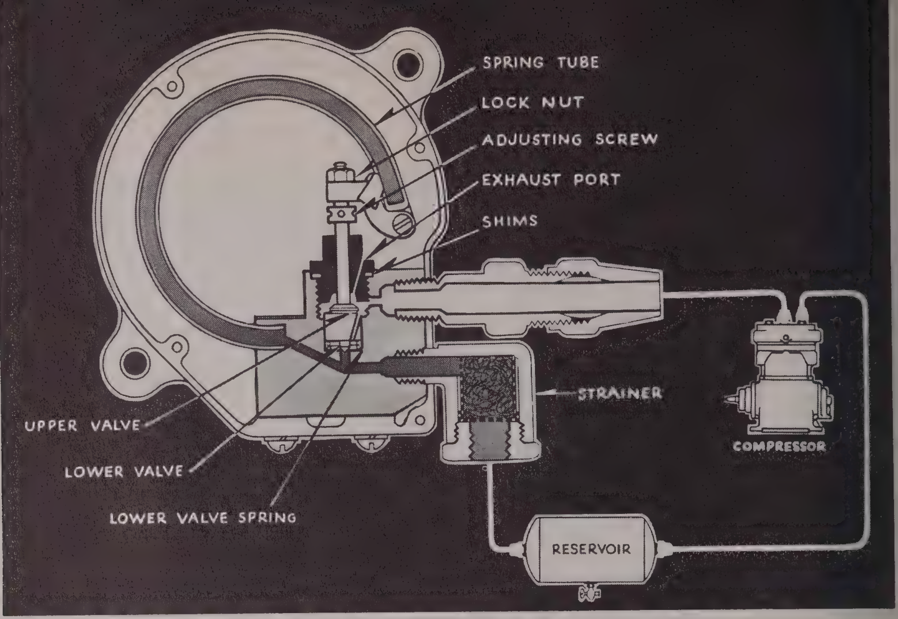


FIG. 5—CUT-IN POSITION (COMPRESSOR OPERATING)

connection to the unloading mechanism of the compressor cylinder head. When this occurs, the unloading valves in the compressor cylinder head are opened and further compression of air is stopped.

As the air pressure in the reservoir drops to the cut in setting of the compressor governor (80-85 lbs.), the pressure of the spring tube on the upper valve increases and forces the upper valve down off its seat. This movement also seats the lower valve preventing reservoir air pressure from passing through the governor. With the upper valve off its seat, air pressure in the unloading diaphragm cavity in the compressor cylinder head escapes through the exhaust port in the governor. This permits the unloading valves in the compressor cylinder head to close and compression is resumed until reservoir pressure again rises to the cut out setting of the governor.

Section II . . . . PREVENTIVE MAINTENANCE

Every six months or after each 10,000 miles.

(1) Remove the governor air strainer and wash all parts in cleaning solvent. Lamb's wool in the air cleaner may be used again if it can be washed thoroughly clean in cleaning solvent, otherwise it must be replaced.

Every year or after each 25,000 miles.

(1) Disassemble governor and clean all parts. (Section V and VI.)

(2) Clean or replace both tubing lines connected to the governor.

Section III . . TESTING FOR SERVICEABILITY

OPERATING TESTS

(1) With the engine running, build up air pressure in the air brake system and observe at what pressure registered by the dash gage the governor cuts out stopping further compression. The governor must cut out between 100 and 105 pounds.

(2) With engine running, slowly reduce the air pressure in the air brake system by applying and releasing the brakes and observe at what pressure registered by the dash gage the governor cuts in and compression is resumed. The governor must cut in between 80 and 85 pounds.

(3) Before condemning or adjusting the pressure settings of the governor, be sure the dash gage is registering accurately. This may be done by using an accurate test gage to check the pressure registered by the dash gage.

(4) When necessary, the pressure settings (cut in and cut out pressures) may be adjusted after removing the cover. The pressure settings are raised by loosening the adjusting screw lock nut and turning the adjusting screw clockwise viewed from the top. (Fig. 4). Pressure settings may be lowered by turning the adjusting screw counter-clockwise. The lock nut must be tightened after any adjustment.

(5) If the governor cannot be adjusted to cut in and cut out at the proper pressure settings, it should be replaced.

LEAKAGE TESTS

(1) Remove cover and with the governor in its cut out position, test for leakage by applying soap suds to the exhaust port (Fig. 4).

(2) With the governor in its cut in position test for leakage by applying soap suds to the exhaust port (Fig. 5).

(3) Leakage in excess of a one inch soap bubble in three seconds is not permissible in either of the above tests. If excess leakage is found, the governor must be replaced.

(4) Install cover after making tests.

Section IV . . . REMOVING and INSTALLING

If it is necessary to remove or install a governor the following procedure will apply:

REMOVING

(1) Drain air brake system.

(2) Disconnect air lines at governor.

(3) Remove governor mounting bolts and remove governor.

INSTALLING

(1) Clean or replace both air lines connected to the governor.

(2) Mount governor in place.

(3) Connect air lines to governor.

(4) Test governor for serviceability (Section III).

Section V . . . . DISASSEMBLY

GENERAL

(1) Remove all dirt or grease from exterior of case using cleaning solvent, and a brush.

(2) Inspect case and cover for breakage or other damage. Case or cover must be replaced if damaged in any way.

(3) Remove cover from case and inspect tube for damage. If the tube is cracked, dented, or broken, the body and tube assembly must be replaced.

DISASSEMBLY

(1) Unscrew air strainer assembly. Remove screw attaching cover to case and remove cover. Remove four screws and lock washers located at bottom of case and remove governor from case.

(2) Remove screw attaching adjusting screw bracket to end of tube (Fig. 6). Remove adjusting screw bracket.

(3) Unscrew upper valve guide using wrench, 202637, (Section X) and remove upper valve guide and upper valve (Fig. 7). Lift out shims from governor body (Fig. 8). Shake out lower valve and lower valve spring. (Fig. 9).

(4) Disassemble air strainer. Unscrew cap nut from air strainer body and remove cup screen, lamb's wool and cylindrical screen from strainer body.

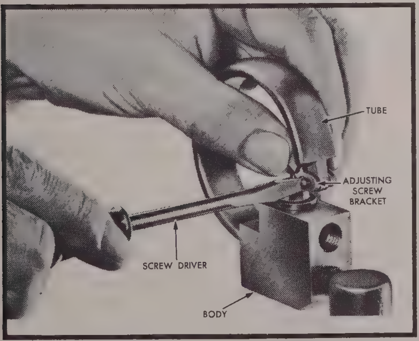


FIG. 6—REMOVING ADJUSTING SCREW BRACKET

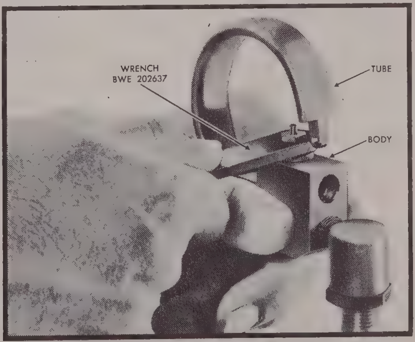


FIG. 7—REMOVING UPPER VALVE GUIDE

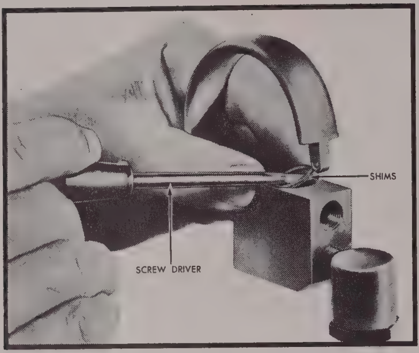

SHIMS
SCREW DRIVER

FIG. 8—REMOVING SHIMS

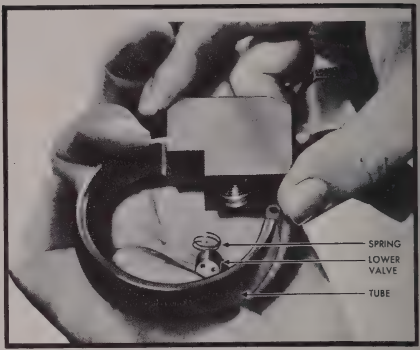

SPRING
LOWER VALVE
TUBE

FIG. 9—REMOVING LOWER VALVE AND SPRING

Section VI . . . CLEANING and INSPECTION OF PARTS

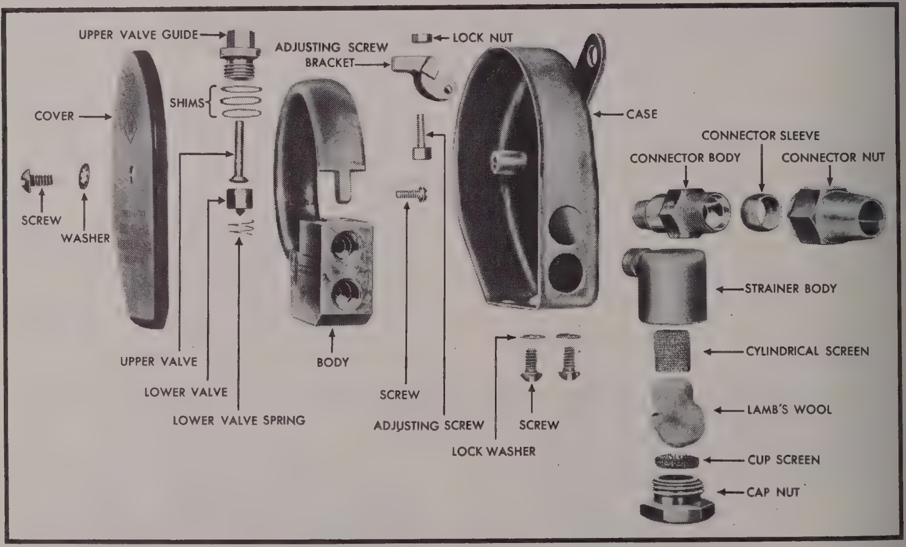

UPPER VALVE GUIDE
ADJUSTING SCREW BRACKET
LOCK NUT
COVER
SHIMS
CASE
CONNECTOR SLEEVE
CONNECTOR BODY
CONNECTOR NUT
SCREW
WASHER
STRAINER BODY
CYLINDRICAL SCREEN
UPPER VALVE
BODY
LOWER VALVE
SCREW
LAMB'S WOOL
LOWER VALVE SPRING
ADJUSTING SCREW
SCREW
LOCK WASHER
CUP SCREEN
CAP NUT

FIG. 10—EXPLODED VIEW OF GOVERNOR

CLEANING AND INSPECTION OF PARTS

Clean all parts. Clean all parts in cleaning solvent and be particularly sure that all passages through the body are not obstructed in any way. Also be sure small drilled passage through lower valve is clean and open. Lamb's wool in the air strainer may be used again if it can be washed thoroughly clean in cleaning solvent, otherwise it must be replaced.

Spring Tube. If the spring tube is damaged in any way, if it leaks, or if it has become loose at the soldered joint at the body, the body and tube assembly must be replaced.

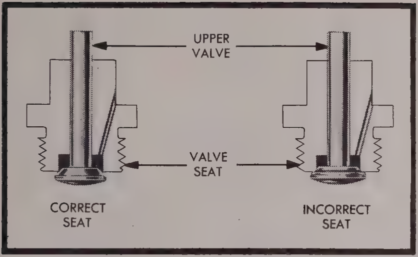

UPPER VALVE
VALVE SEAT
CORRECT SEAT
INCORRECT SEAT

FIG. 11—CORRECT AND INCORRECT UPPER VALVE SEATS

Upper Valve and Upper Valve Guide. Inspect seat on upper valve and upper valve guide for wear or damage. Also check fit of upper valve stem in upper valve guide. If the seat on the upper valve shows a decided groove from wear (Fig. 11) or if the upper valve system is not a neat sliding fit in the upper valve guide, the upper valve and upper valve guide must be replaced as an assembly.

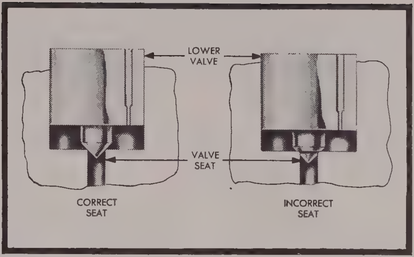

LOWER VALVE
VALVE SEAT
CORRECT SEAT
INCORRECT SEAT

FIG. 12—CORRECT AND INCORRECT LOWER VALVE SEATS

Lower Valve and Lower Valve Seat. Inspect lower valve for wear or damage. If the valve is grooved excessively (Fig. 12), it must be replaced. Check fit of lower valve in body. It must be a neat sliding fit. If excessive clearance is evident, the lower valve must be replaced.

Section VII . . . . REPAIRS

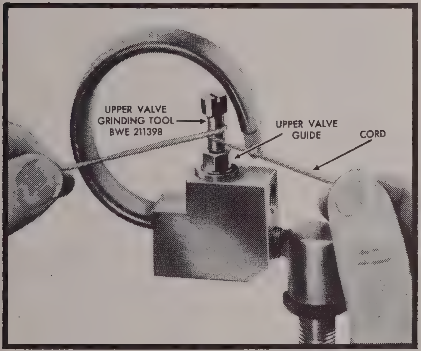

UPPER VALVE GRINDING TOOL BWE 211398
UPPER VALVE GUIDE
CORD

FIG. 13—GRINDING UPPER VALVE

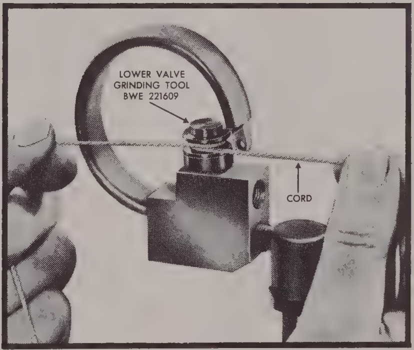

LOWER VALVE GRINDING TOOL BWE 221609
CORD

FIG. 14—GRINDING LOWER VALVE

Upper Valve and Upper Valve Guide. If the upper valve and seat are not too badly worn, they are repaired by carefully grinding the valve to its seat using grinding tool, 211398, (Section X) and Bendix-Westinghouse grade 1000 grinding compound. When grinding upper valve, temporarily screw upper valve and upper valve guide in place in body (Fig. 7). Do not use ordinary valve grinding compound as this cuts too fast and it is impossible to obtain a good seal. The valve must be turned back and forth during the grinding operation by using a piece of cord and the cord should be pulled in such a manner as to keep the upper valve contacting the upper valve guide during the grinding operation. Clean valve and valve seat after grinding in cleaning solvent.

Lower Valve and Valve Seat.

(a) If leakage is due to a worn or damaged lower valve and seat, and the wear or damage is not excessive, the lower valve may be ground to its seat using grinding tool, piece 221609, (Section X) and Bendix-Westinghouse grade 1000 grinding compound (Fig. 14). Do not use ordinary valve grinding compound.

(b) If a new lower valve is being installed, tapping the valve to its seat before grinding is usually helpful. To do this put lower valve in place and install upper valve and upper valve guide. Then using valve seating tool, 211397, (Section X) and lightly tap the lower valve to its seat a few times.

(c) Clean valve and governor body thoroughly with cleaning solvent after grinding.

(d) If leakage of the lower valve cannot be corrected by the above procedure, the body and tube assembly must be replaced.

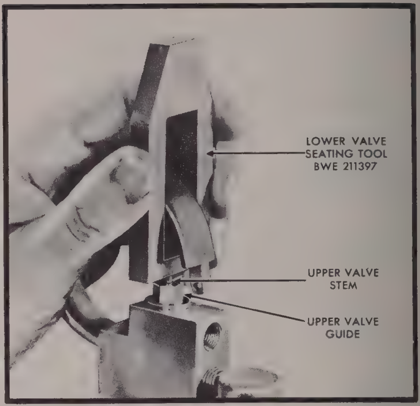


FIG. 15—SEATING LOWER VALVE WITH SEATING TOOL

Section VIII . . . . ASSEMBLY

(a) Parts must be thoroughly clean.

(b) Install lower valve spring and lower valve in lower valve recess of governor body. Install shims in governor body. Insert upper valve stem through upper valve guide and screw upper valve and guide into place. Tighten securely using wrench, piece 202637. Install adjusting screw and adjusting screw lock nut in adjusting screw bracket. Position adjusting screw bracket in place on end of spring tube and install attaching screw.

(c) Position governor in case, and install four mounting screws and lock washers. Position cover on case and install attaching screw and lock washer.

(d) Pack cylindrical strainer screen with new or cleaned lamb's wool and place cylindrical strainer screen in strainer body. Position cup strainer screen over the end of cylindrical screen in strainer body and install strainer cap nut. Screw air strainer assembly into lower connection in governor body and position (Fig. 3).

Section IX . TEST and ADJUSTMENT OF REBUILT GOVERNOR

TEST

If facilities are available the rebuilt governor can be tested on a suitable test rack. If such facilities are not available, the governor can be tested on the vehicle (Section III).

Both operating tests and leakage tests must be made in either case so the governor meets the following specifications:

(1) The governor must cut out between 100 and 105 pounds.

(2) The governor must cut in between 80 and 85 pounds.

(3) Leakage in both the cut out and cut in positions must not exceed a one inch soap bubble in three seconds.

ADJUSTMENT

Adjustment of the pressure settings is made by loosening the lock nut and turning the adjusting screw (Fig. 4). Adjustment of the range between the cut in and cut out pressure is made by removing shims beneath the upper valve guide (Fig. 8) to increase the range or by installing additional shims to decrease the range.

Section X . . . . SPECIAL TOOLS

The special tools required to adjust and repair the type O-1 Governor are illustrated in Figure 16.

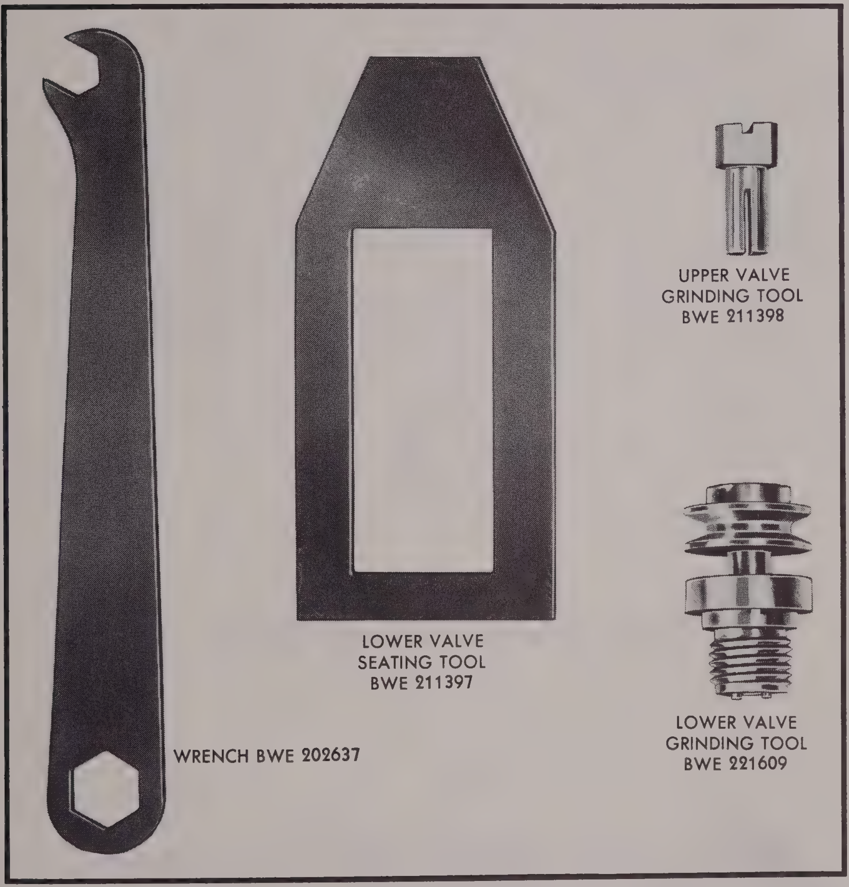

UPPER VALVE
GRINDING TOOL
BWE 211398
LOWER VALVE
SEATING TOOL
BWE 211397
WRENCH BWE 202637
LOWER VALVE
GRINDING TOOL
BWE 221609

FIG. 16—SPECIAL TOOLS FOR REPAIRING GOVERNORS

SAFETY STANDARD OF THE WORLD

Bendix-Westinghouse

BENDIX-WESTINGHOUSE
AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

Printed in U. S. A.

B-W I-P 5066

TYPE HP
BRAKE VALVE
(HAND OPERATED)

BENDIX-WESTINGHOUSE GENUINE AIR BRAKES

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

INSTRUCTION PAMPHLET
No. 5067

ISSUED JULY, 1945

TYPE HP
BRAKE VALVE
(HAND OPERATED)

Section I . . . DESCRIPTION and OPERATION
Section II . . . . PREVENTIVE MAINTENANCE
Section III . . TESTING FOR SERVICEABILITY
Section IV . . . REMOVING and INSTALLING
Section V . . . . DISASSEMBLY
Section VI . . . CLEANING, INSPECTION OF PARTS and REPAIRS
Section VII . . . . ASSEMBLY
Section VIII . . . TEST and ADJUSTMENT OF REBUILT BRAKE VALVE

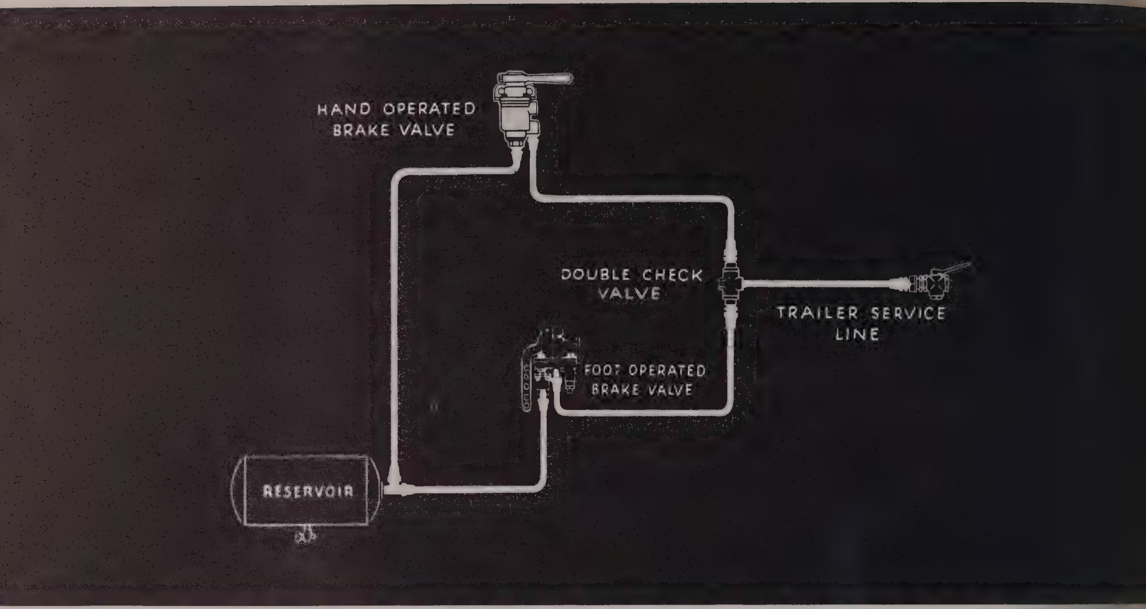

HAND OPERATED BRAKE VALVE
DOUBLE CHECK VALVE
TRAILER SERVICE LINE
FOOT OPERATED BRAKE VALVE
RESERVOIR

FIG. 1—PIPING DIAGRAM OF TYPE HP BRAKE VALVE

Section I . . . DESCRIPTION and OPERATION

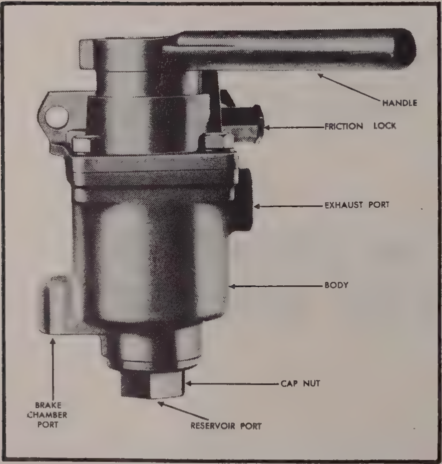

HANDLE
FRICTION LOCK
EXHAUST PORT
BODY
CAP NUT
BRAKE CHAMBER PORT
RESERVOIR PORT

FIG. 2—TYPE HP BRAKE VALVE

DESCRIPTION

Type HP brake valves are used for controlling the brakes on a trailer independently of the brakes on the towing vehicle. They are usually mounted on the steering column or on the dash and the driver may put the handle in any one of several positions between brakes released and brakes fully applied position so the brakes on the trailer are kept applied until the brake valve handle is returned to release position. The distance the brake valve handle is moved in a clockwise direction toward applied position determines the severity of the brake application. The driver may, therefore, control the brakes on the trailer as the speed, load, and road conditions require.

OPERATION

As the brake valve handle is moved toward applied position, pressure is exerted on the top of the pressure regulating spring and the piston assembly moves downward. When this happens, the exhaust valve seat engages the exhaust valve and closes the passage to the exhaust port. The exhaust valve and the inlet valve are part of the same assembly, therefore, after the exhaust valve is closed and the piston assembly continues its movement downward, the inlet valve is forced off its seat. This permits air pressure from the reservoir to pass through the inlet valve and out the connection leading to the service line and the brakes on the trailer.

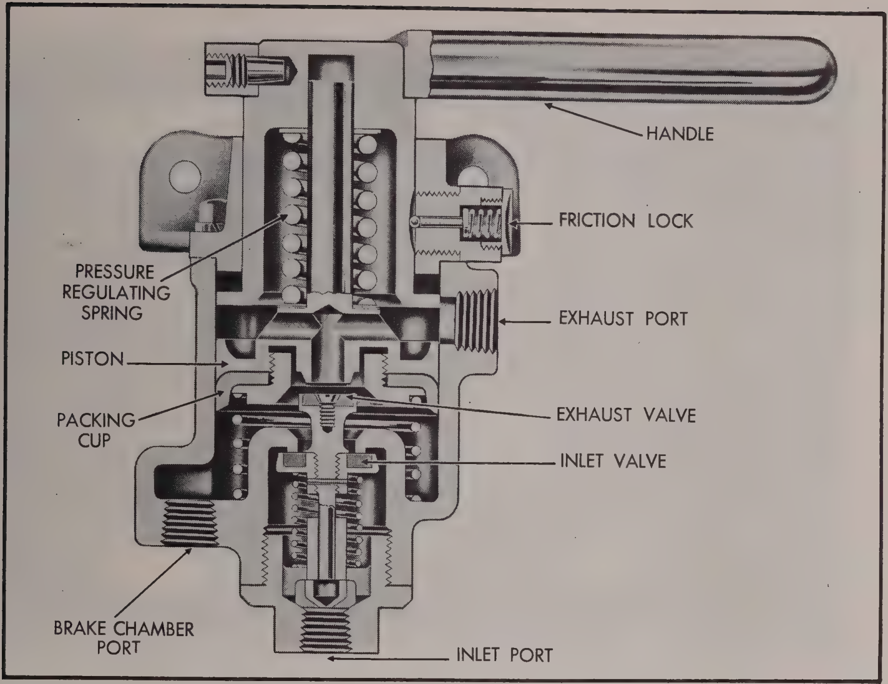

HANDLE
FRICTION LOCK
PRESSURE REGULATING SPRING
EXHAUST PORT
PISTON
EXHAUST VALVE
PACKING CUP
INLET VALVE
BRAKE CHAMBER PORT
INLET PORT

FIG. 3—SECTIONAL VIEW OF TYPE HP BRAKE VALVE

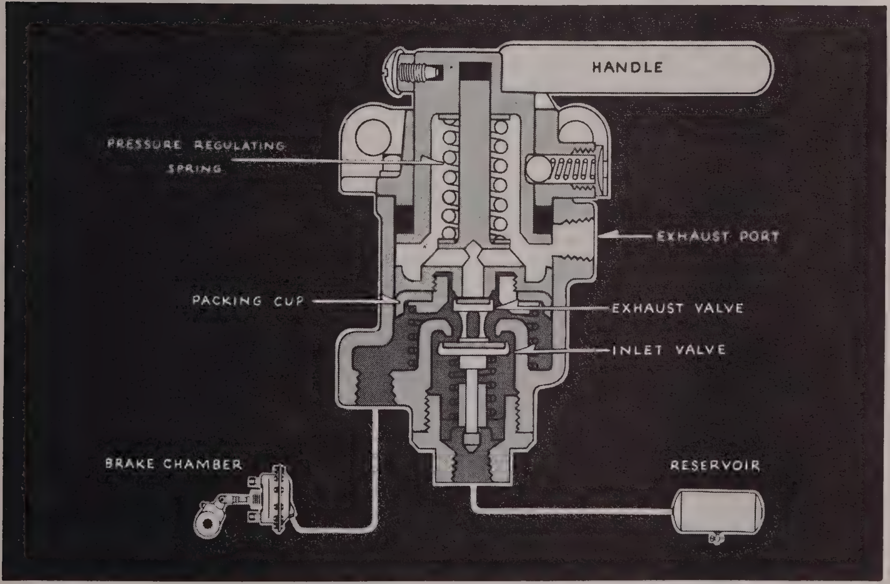

HANDLE
PRESSURE REGULATING SPRING
EXHAUST PORT
PACKING CUP
EXHAUST VALVE
INLET VALVE
BRAKE CHAMBER
RESERVOIR

FIG. 4—APPLYING POSITION

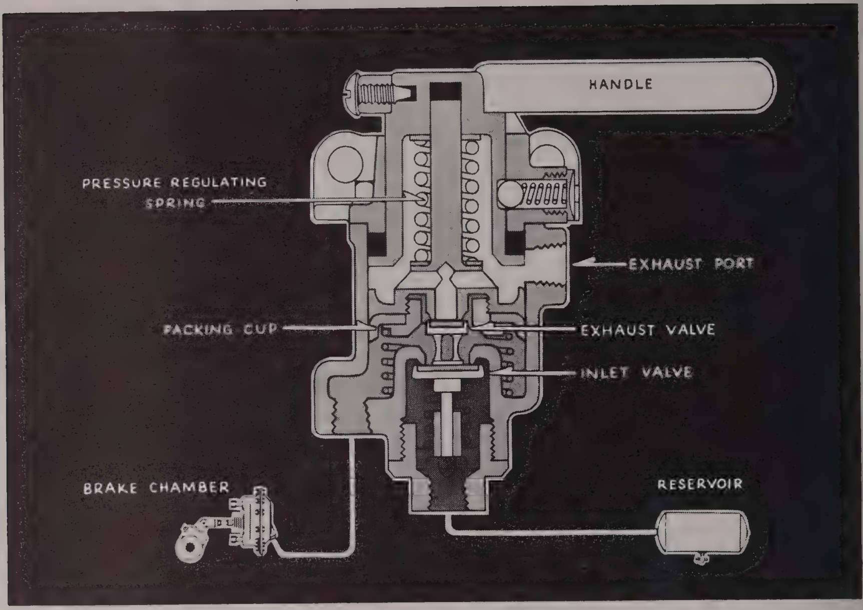

HANDLE
PRESSURE REGULATING SPRING
EXHAUST PORT
PACKING CUP
EXHAUST VALVE
INLET VALVE
BRAKE CHAMBER
RESERVOIR

FIG. 5—HOLDING POSITION

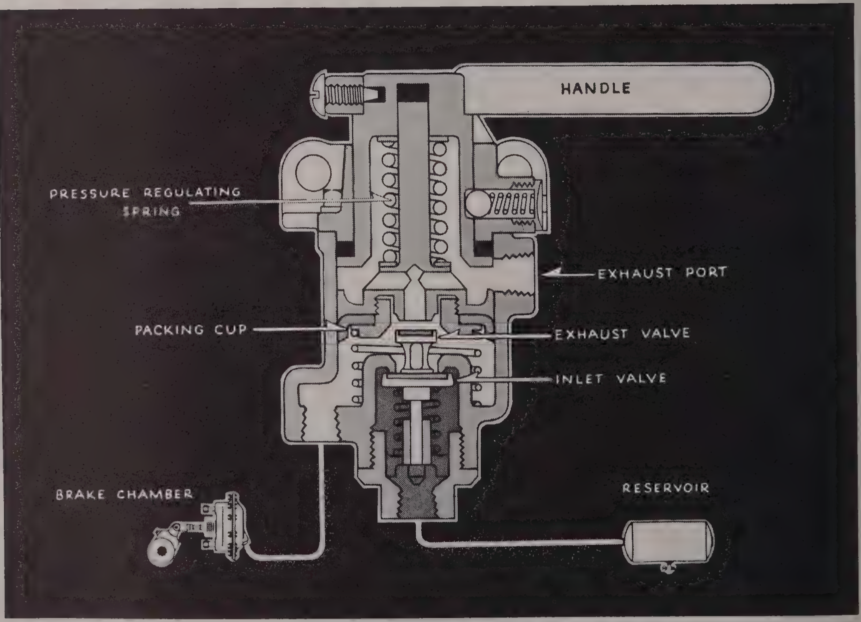

HANDLE
PRESSURE REGULATING SPRING
EXHAUST PORT
PACKING CUP
EXHAUST VALVE
INLET VALVE
BRAKE CHAMBER
RESERVOIR

FIG. 6—RELEASING POSITION

As soon as the air pressure below the piston assembly overcomes the mechanical force on top of it, the piston assembly lifts, the intake valve closes cutting off any further air supply, and the exhaust valve remains closed preventing any loss of air pressure through the exhaust port. Any further movement of the handle toward fully applied position adds additional mechanical force on top of the piston assembly and correspondingly increases the delivered air pressure..

If the brake valve handle is moved toward released position, the mechanical force on top of the piston assembly is decreased. This permits the air pressure below the piston assembly to lift it still further thus opening the exhaust valve and permitting air pressure to exhaust from the service line until a lower air pressure is established to balance the lesser mechanical force acting on top of the piston assembly.

In this manner, the brake application on the trailer may be graduated during both application or release of the brakes and the position of the brake valve handle always determines the air pressure being delivered through the service line to the trailer brake equipment.

The handle of the brake valve is fitted with a friction lock so it will remain in whatever position it is placed by the driver. The brake valve should never be used, however, to hold the brakes applied when vehicles are being parked or when the driver is off duty. If the vehicles are parked on a hill or grade, other precautions such as blocking the wheels must be taken as there is a possibility the air pressure in the system may be depleted due to leakage and the brakes release after a reasonable lapse of time.

Section II . . . . PREVENTIVE MAINTENANCE

Every year or after every 50,000 miles.

(1) Disassemble brake valve and clean all parts (Sections V and VI.) Install new inlet and exhaust valve assembly and new packing cup.

Section III . . TESTING FOR SERVICEABILITY

OPERATING TESTS

(1) Check the delivery pressure of the brake valve using an accurate air pressure test gauge. The test gauge may be conveniently connected to the service line outlet at the rear of the vehicle. With the brake valve handle moved to its fully applied position, the brake valve must deliver at least sixty pounds pressure.

(2) Move the brake valve handle to several different positions between fully applied and fully released positions and observe that the air pressure registered by the test gauge varies in accordance with the position to which the handle is moved.

LEAKAGE TESTS

(1) With brake valve handle in released position, coat the exhaust port with soap suds to check for leakage.

(2) With brake valve handle in fully applied position, coat the exhaust port with soap suds to check for leakage.

(3) Leakage in excess of a one inch soap bubble in one second is not permissible in either of these tests. If excessive leakage is found it will usually be caused by dirty or worn valves or valve seats and the inlet and exhaust valve assembly or the complete brake valve must be repaired or replaced. Leakage due to dirty valves and valve seats may be corrected by removing the inlet and exhaust valve assembly and cleaning the valves and valve seats. Leakage due to worn valves may be corrected by installing a new inlet and exhaust valve assembly. If the valve seats are pitted or worn excessively or if the installation of a new inlet and exhaust valve assembly does not correct the leakage, the brake valve must be repaired or replaced.

Section IV . . . REMOVING and INSTALLING

If it is necessary to remove or install a brake valve the following procedure will apply:

REMOVING

(1) Drain air brake system.

(2) Disconnect air lines at brake valve.

(3) Remove mounting bolts, and remove brake valve.

INSTALLING

(1) Mount brake valve in position.

(2) Connect air lines to brake valve.

(3) Be sure exhaust port is not plugged.

(4) Test brake valve for serviceability (Section III).

Section V . . . . DISASSEMBLY

GENERAL

Remove all dirt and grease from exterior of valve using cleaning solvent and a brush. Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

DISASSEMBLY

(1) Remove set screw from handle and lift off handle (Fig. 7).

(2) Remove four cap screws and lock washers attaching cover to body and lift off cover. Unscrew friction lock assembly from cover and disassemble. Remove washer, pressure regulating spring, and shims from piston. Pull piston assembly out of body and lift out exhaust valve spring.

(3) Disassemble piston by engaging the slots in the piston follower with a steel bar and unscrewing the piston using a steel rod (Fig. 8).

(4) Remove cap nut from bottom of body and lift out inlet and exhaust valve assembly and spring.

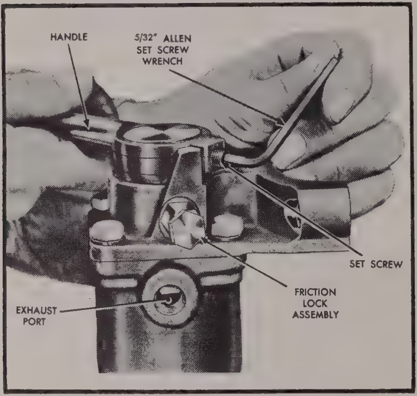


FIG. 7—REMOVING HANDLE

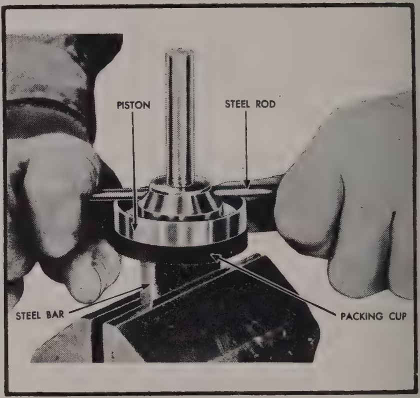


FIG. 8—DISASSEMBLY OF PISTON

Section VI. CLEANING, INSPECTION OF PARTS and REPAIRS

Clean all metal parts using cleaning solvent. Replace all damaged or excessively worn parts. Inspect condition of packing cup and replace with new cup if it is worn thin or damaged in any way. Check piston bore in body for excessive wear, scoring or out-of-roundness. Bore must be smooth and round. If diameter of bore exceeds 2.133 inches, the body must be replaced. Check fit of piston in body. Piston must be a neat sliding fit.

Inspect inlet and exhaust valve assembly to be sure rubber seats are in good condition. Do not attempt to replace seats. If seats are worn or damaged, replace the complete inlet and exhaust valve assembly.

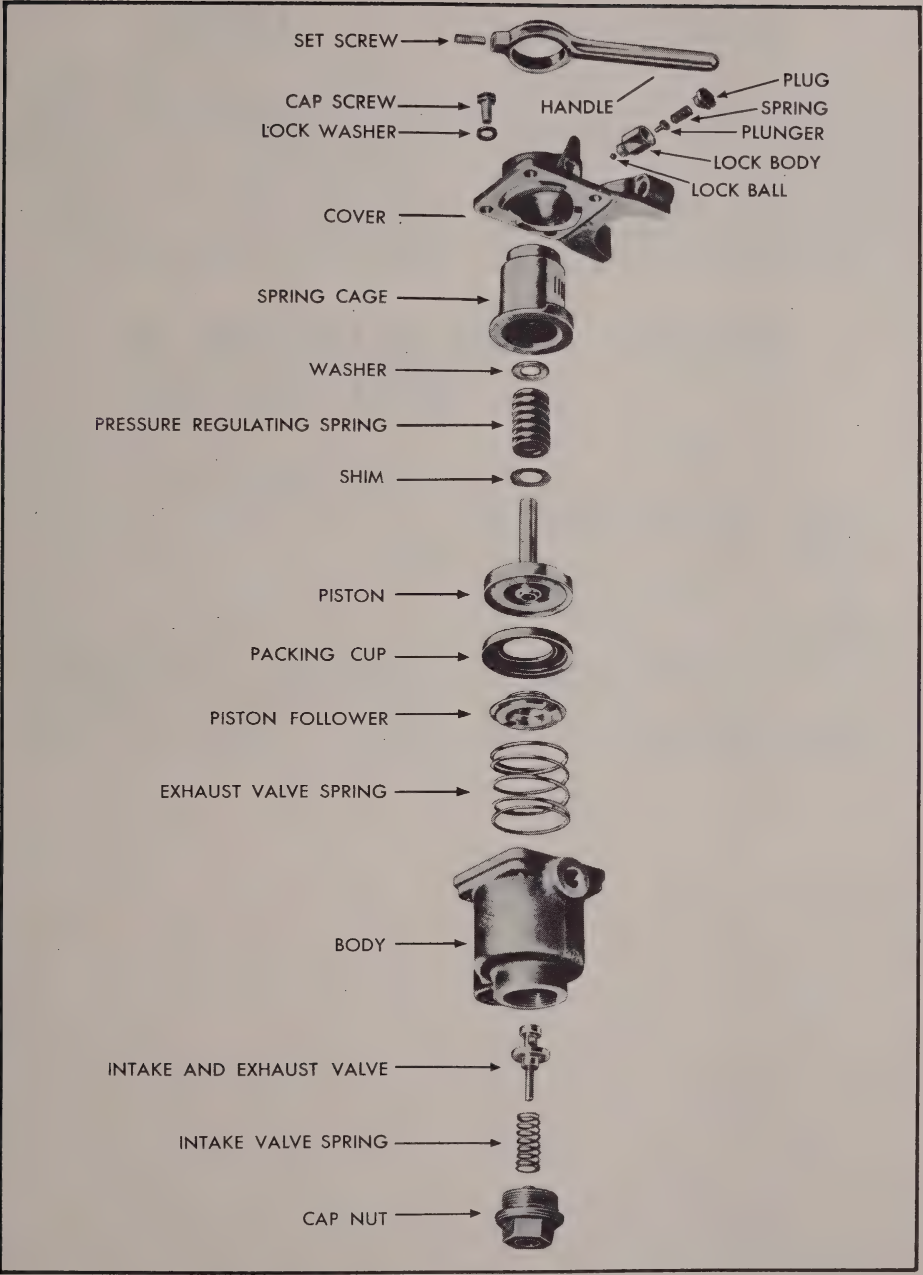

SET SCREW
CAP SCREW
LOCK WASHER
HANDLE
PLUG
SPRING
PLUNGER
LOCK BODY
LOCK BALL
COVER
SPRING CAGE
WASHER
PRESSURE REGULATING SPRING
SHIM
PISTON
PACKING CUP
PISTON FOLLOWER
EXHAUST VALVE SPRING
BODY
INTAKE AND EXHAUST VALVE
INTAKE VALVE SPRING
CAP NUT

FIG. 9—EXPLODED VIEW OF TYPE HP BRAKE VALVE

Section VII . . . . ASSEMBLY

(a) Position piston packing cup in bottom of piston. Screw piston follower into piston sufficiently tight to make a good air seal at the piston packing cup but not sufficiently tight to distort or damage the packing cup (Fig. 8). Place inlet and exhaust valve spring over inlet and exhaust valve assembly. Position the two parts in the cap nut and enter the assembled parts into the valve body with the seats of the valves toward the top of the body. Tighten cap nut securely. Lubricate the piston packing cup with graphite grease then place exhaust valve spring into top of body and enter piston assembly into body over exhaust valve spring. Exercise extreme care so as not to damage the piston packing cup. Place the shim washers (thin) over piston stem and install pressure regulating spring. Then place washer (thick) over piston stem and on top of spring. Enter spring cage into bottom of cover. Place cover in position on body with spring cage over end of piston next to washer. Position cover so the mounting bracket is at the rear when the brake chamber port is at the left (Fig. 3). Install four cap screws and lock washers attaching cover to body. Assemble and install friction lock assembly. Place handle in position over spring cage and secure it in position with set screw.

Section VIII . . . TEST and ADJUSTMENT OF REBUILT BRAKE VALVE

TEST

If facilities are available the rebuilt brake valve can be tested on a suitable test rack. If such facilities are not available, the brake valve can be tested on the vehicle (Section III).

Both operating tests and leakage tests must be made in either case so the brake valve meets the following specifications:

(1) The brake valve must deliver at least 60 pounds when the handle is moved to fully applied position.

(2) The brake valve must graduate the delivered pressure depending on the position in which the brake valve handle is placed.

(3) Leakage at the exhaust port in both the fully applied or fully released positions must not exceed a one inch soap bubble in one second.

(4) No leakage is permissible at any other point on the brake valve with the brake valve handle in applied position.

ADJUSTMENT

If the delivered pressure is below 60 pounds with the brake valve handle in fully applied position additional shims may be needed beneath the pressure regulating spring. If this does not correct the condition, the pressure regulating spring must be replaced. Care must be used in installing shims to be sure the exhaust valve opening is not reduced sufficiently to cause slow release.

BENDIX-WESTINGHOUSE
GENUINE
AIR BRAKES

SAFETY STANDARD OF THE WORLD

Bendix-Westinghouse

BENDIX-WESTINGHOUSE
AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

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B-W I-P 5067

SERVICE BULLETIN

VENDOR: Hendrickson Motor Truck Company

DA-5325 Air Brake Piping Diagram For 360-4-T

SEE INSIDE

Copper Tubing	3/8" diam. x 84" long	Loom 7/16" diam. x 72" long
Copper Tubing	3/8" diam. x 132" long	Loom 7/16" diam. x 120" long
Copper Tubing	3/4" diam. x 120" long	Loom 3/16" diam. x 108" long
Rubber Hose Assembly	22" long (male ends)	
Copper Tubing	1/2" diam. x 12" long	Loom 9/16" diam. x 9" long
Copper Tubing	3/8" diam. x 132" long	Loom 7/16" diam. x 120" long
Copper Tubing	3/8" diam. x 18" long	Loom 7/16" diam. x 12" long
Copper Tubing	3/8" diam. x 120" long	Loom 7/16" diam. x 108" long
Copper Tubing	1/4" diam. x 18" long	Loom 5/16" diam. x 12" long
Copper Tubing	1/2" diam. x 60" long	Loom 9/16" diam. x 48" long
Copper Tubing	3/8" diam. x 88" long	Loom 7/16" diam. x 76" long
Copper Tubing	3/8" diam. x 6" long	Loom 7/16" diam. x 4" long
Copper Tubing	3/4" diam. x 41" long	Loom 13/16" diam. x 29" long
Copper Tubing	3/8" diam. x 36" long	Loom 7/16" diam. x 26" long
Copper Tubing	3/8" diam. x 96" long	Loom 7/16" diam. x 84" long
Copper Tubing	5/8" diam. x 94" long	Loom 11/16" diam. x 82" long
Copper Tubing	5/8" diam. x 108" long	Loom 11/16" diam. x 96" long
Copper Tubing	3/8" diam. x 18" long	Loom 7/16" diam. x 15" long
Copper Tubing	3/8" diam. x 24" long	Loom 7/16" diam. x 21" long
Copper Tubing	3/8" diam. x 132" long	Loom 7/16" diam. x 120" long
Copper Tubing	5/8" diam. x 156" long	Loom 11/16" diam. x 144" long
Copper Tubing	5/8" diam. x 96" long	Loom 11/16" diam. x 84" long
Copper Tubing	5/8" diam. x 168" long	Loom 11/16" diam. x 156" long
Copper Tubing	3/8" diam. x 31" long	Loom 7/16" diam. x 21" long
Copper Tubing	3/8" diam. x 23" long	Loom 7/16" diam. x 19" long
Copper Tubing	3/8" diam. x 30" long	Loom 7/16" diam. x 20" long
Copper Tubing	3/8" diam. x 38" long	Loom 7/16" diam. x 26" long
Copper Tubing	5/8" diam. x 48" long	Loom 11/16" diam. x 36" long
Copper Tubing	3/8" diam. x 18" long	Loom 7/16" diam. x 14" long
Copper Tubing	5/8" diam. x 36" long	Loom 11/16" diam. x 24" long
B. W. 101-M 31" long		
B. W. 101-M 31" long		
Hose B. W. 101-M 28" long		
Hose B. W. 101-M 28" long		
Copper Tubing	3/8" diam. x 108" long	Loom 7/16" diam. x 96" long
Copper Tubing	5/8" diam. x 12" long	Loom 11/16" diam. x 9" long

SAFETY STANDARD OF THE WORLD

BENDIX-WESTINGHOUSE
AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

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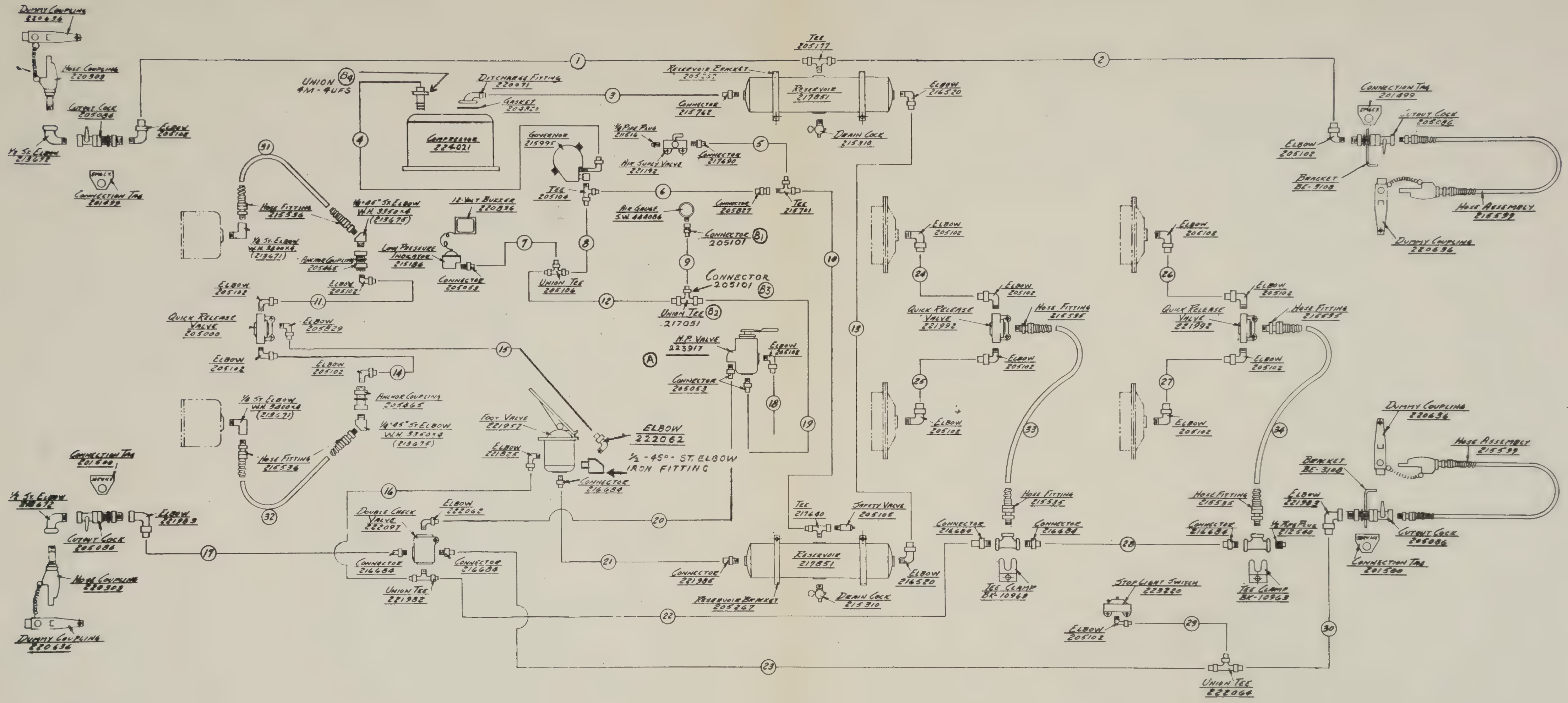
Dummy Coupling 220636
Hose Coupling 220303
Cutout Cock 205086
½ St. Elbow 213672
Elbow 205102
Connection Tag 201499
Union 4M-4UFS B4
Discharge Fitting 220071
Gasket 204820
Compressor 224021
Tee 205177
Reservoir Bracket 205257
Reservoir 217851
Connector 215762
Elbow 216520
Drain Cock 215310
Governor 215995
¼ Pipe Plug 211616
Air Supply Valve 221192
Connector 217690
Tee 205104
Connector 205827
Tee 215701
Air Gauge S.W. 444086
Connector 205101 B1
Connector 205101 B3
Union Tee 217051 B2
12-Volt Buzzer 220836
Low Pressure Indicator 215186
Connector 205053
Union Tee 205106
Hose Fitting 215536
⅜-45° St. Elbow W.H. 3350×4 (213675)
⅜ St. Elbow W.H. 3400×4 (213671)
Anchor Coupling 205465
Elbow 205102
Quick Release Valve 205000
Elbow 205829
H.P. Valve 223917
A
Elbow 205102
Connector 205053
Foot Valve 221957
Elbow 222062
½-45°-St. Elbow Iron Fitting
Elbow 221825
Connector 216684
Double Check Valve 222097
Elbow 222062
Connector 216684
Union Tee 221982
Connection Tag 201500
½ St. Elbow 213672
Cutout Cock 205086
Elbow 221983
Hose Coupling 220303
Dummy Coupling 220636
Tee 217640
Safety Valve 205105
Connector 221986
Reservoir 217851
Reservoir Bracket 205267
Drain Cock 215310
Elbow 216520
Quick Release Valve 221992
Hose Fitting 215535
Elbow 205102
Connector 216684
Tee Clamp BK-10963
Stop Light Switch 223220
Elbow 205102
Union Tee 222064
½ Pipe Plug 212540
Elbow 221983
Bracket BE-3108
Cutout Cock 205086
Connection Tag 201500
Hose Assembly 215599
Dummy Coupling 220636
Connection Tag 201499
Elbow 205102
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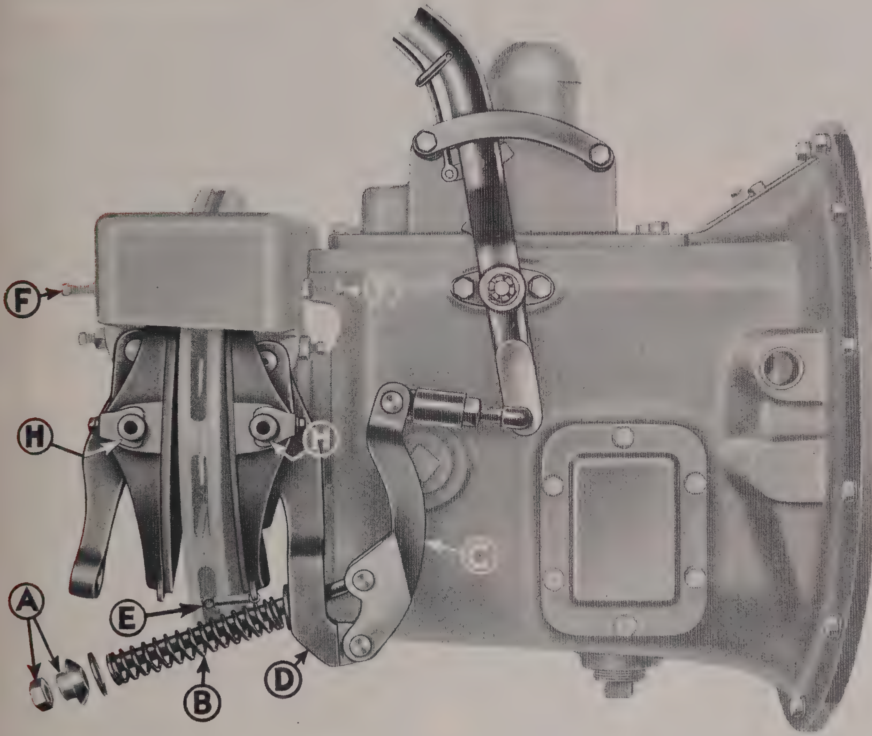
AIR BRAKE PIPING DIAGRAM -- FOR 360-4-T
(WAYNE CRANE, 52" TANDEM SPACING)

RELINING

TRU-STOP VENTILATED DISC BRAKES

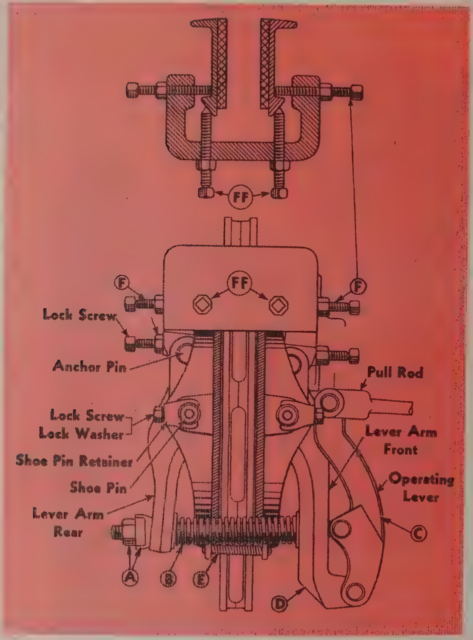


1. Remove nuts A.
2. Remove spring E.
3. Apply hand lever so that rear arm can be swung back clear of tie rod and spring.
4. Remove shoe pin locks H, and drop shoe.
5. Replace relined shoes and adjust as per instructions on preceding page.

IMPORTANT — Brake linings approved for use on Tru-Stop Brakes are special linings for this particular application. Ordinary brake lining will not give the performance for which the brake is designed. Always use genuine Tru-Stop linings. Keep a stock of brake shoes already lined — brake shoes are perfectly interchangeable.

AUTOMOTIVE AND AIRCRAFT DIVISION
American Chain & Cable Company, Inc.
Stephenson Building
Detroit, Michigan
1119 Santa Fe Ave.
Los Angeles, Calif.

TRU-STOP VENTILATED DISC BRAKES



TWO SHOE BRAKES

1. Disconnect pull rod from lever "C".

2. Tighten nut "A" so that spring "B" exerts enough pressure to bring lever "C" to stop solidly against lever arm "D".

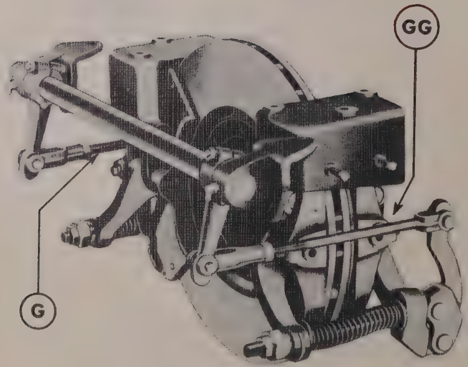
3. Insert 1/32 shim between front shoe lining and disc.

4. Further tighten nut "A" so that rear shoe lining is firm against disc but so that shim in front can still be removed. Remove shim.

5. See that shoe spring "E" is in place, then adjust shoe stop screws "F" or "FF" so that linings are parallel with disc.

NOTE: Some brakes have shoe stop screws at "F" and others at "FF". Adjustment is made with nut "A" and the only pressure shoe stop screws "F" or "FF" should exert against the shoe is to overcome the tension of shoe spring "E" in making the shoes parallel with the disc.

6. Be sure hand lever is in full released position, then adjust pull rod to proper length and make final connections.



FOUR SHOE BRAKES

Adjustment of the four shoe brake is the same as for the two shoe with the following exceptions:

1. Disconnect cross shaft to brake rods "G" and "GG".

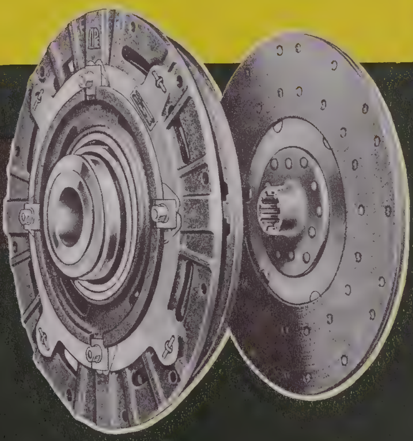
2. Adjust each pair of brake shoes as outlined above. Be sure hand brake lever is in full released position, then adjust cross shaft to brake rods to proper length and make final connections.

NOTE: In full released position operating lever "C" must press firmly against lever arm "D" at the tie rod boss.

Lipe-ROLLWAY

CLUTCH SERVICE MANUAL

Type ML



Lipe-ROLLWAY CORPORATION
Syracuse 1, N. Y.

TYPE ML CLUTCHES

Table of Contents

	Page
Clutch Construction	3
Clutch Operation	3
Identification of Models and Parts	3
Clutch Adjustment	4
Clutch Overhaul	8
Clutch Assembly	10
Clutch Installation	15
Sectional View of Single-Plate Clutches	17
Sectional View of Two-Plate Clutches	18
Types of Driven Disc Assemblies	19

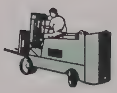
This manual is designed to help you get better results from your Lipe clutches.

It explains, in detail, all the things you need to know about Lipe clutch construction, installation, adjustment and repair.

Follow carefully the instructions and suggestions given in the manual. Lipe clutches will give excellent service under any circumstances, but you will get even better results if you follow the procedures shown in this manual. If you have any questions about procedure, please feel free to write to our Service Department.

Lipe clutches and parts are the finest which can be made. Their design is simple and practical. They are manufactured by modern, precision methods from materials of the highest quality. This is why you'll find it profitable to use, or continue to use Lipe clutches.

Lipe Clutches are Standard on Heavy Equipment Throughout the World



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Form No. S450
Issued Nov. 1952
6M-MO

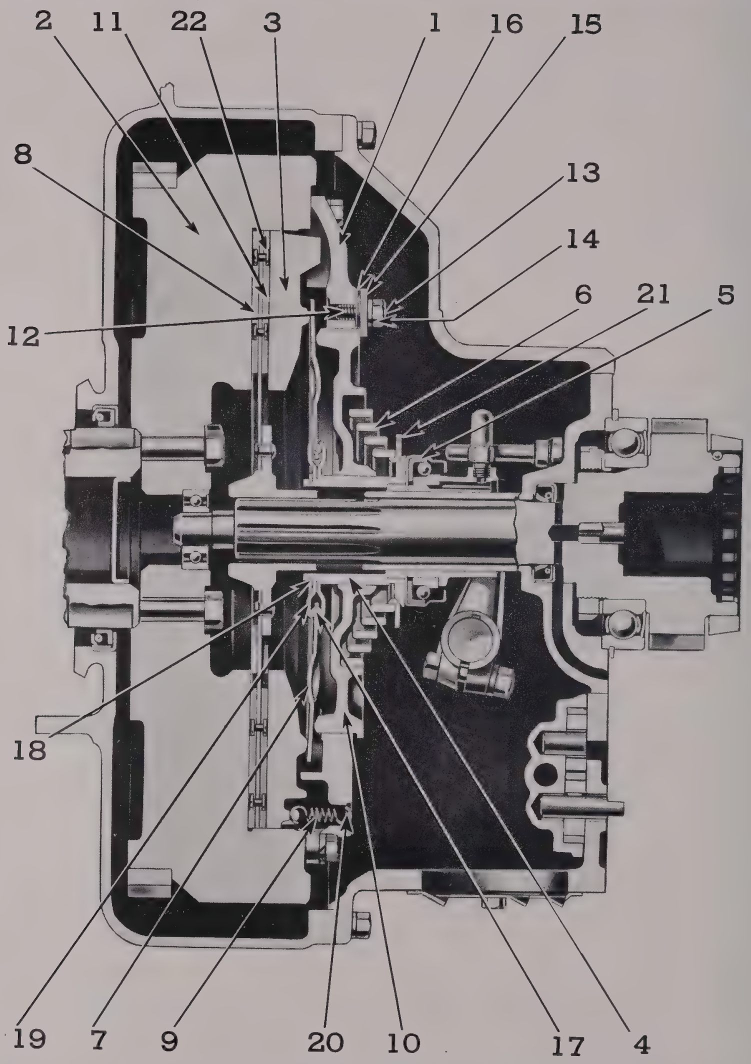


FIGURE 1. *Operation of Lipe Type ML (Multiple Lever) Clutch.*

1. Clutch Flywheel Ring
2. Engine Flywheel
3. Pressure Plate
4. Sleeve
5. Clutch Release Bearing
6. Pressure Spring
7. Pressure Levers
8. Driven Disc Assembly
9. Retractor Spring
10. Adjusting Plate
11. Driven Disc Facing
12. Flywheel Ring Stud
13. Flywheel Ring Stud Nut
14. Flywheel Ring Stud Nut Lockwasher
15. Adjusting Strap
16. Adjusting Shims
17. Lever Locking Balls
18. Snap Ring
19. Fulcrum Rings
20. Spring Retainer Pin
21. Spring Equalizer Ring
22. Facing Rivets

Important! Use Only GENUINE LIPE PARTS

TYPE ML CLUTCHES

CONSTRUCTION

The Lipe Type ML (multiple lever) clutch is of the adjustable, dry disc, push type construction. It is a simple, precision-built, heavy-duty unit embodying few parts. Maintenance can be accomplished very easily without the use of special tools. Adjustment, to compensate for facing wear, is simple, and is accomplished by removing shims. This simple operation also restores the original spring pressure and does not disturb the running balance of the clutch. Thus long clutch life and smooth operation are maintained.

OPERATION

The operation of the Lipe Type ML clutch is illustrated on Page 2, Fig. 1. The clutch flywheel ring (1) is attached to the engine flywheel (2) by means of driving lugs of the pressure plate fitting into mating slots in the flywheel ring.

To disengage this unit, the release sleeve (4) is pushed towards the engine flywheel (2) by the clutch release bearing (5) compressing the pressure spring (6), thus relieving the twenty pressure levers (7) of spring pressure. The pressure plate (3) is retracted from contact with the driven disc assembly (8) by means of pressure plate retracting springs (9), thus accomplishing complete clutch release.

During engagement, the clutch release sleeve (4) is allowed to move out away from the engine flywheel (2) at which time the spring pressure is transmitted through the twenty pressure levers (7) which multiply the spring pressure and deliver it to the pressure plate (3). These twenty pressure levers (7) bear against the continuous fulcrums of both the adjusting plate (10) and the pressure plate (3) which provides for parallel movement of the pressure plate (3) toward the engine flywheel (2). The basic design of this clutch provides for parallel movement of the pressure plate (3) which allows every square inch of the driven disc facing (11) to be contacted at the same moment, thus providing a smooth clutch engagement. The twenty pressure levers (7) also tend to cushion the engagement of the clutch and make for smooth non-shock loading. These same pressure levers (7) are louvered to provide a fan-like cooling of the clutch.

IDENTIFYING MODELS AND PARTS

1. The model and serial numbers of the clutch cover plate assemblies are stamped on the machined surface of the cover or on the nameplate. A change in model and serial numbers was made in May 1944. Prior to this change, model numbers were: Z34S, Z38S, Z42S, Z40SX, etc., and serial numbers were 1210591, 151690, 21543, etc. The new *model* numbers are 120-1-340, 140-1-308, 130-2-330, 150-2-373, etc. The first three digits of these model numbers are the nominal clutch sizes, i. e., 120- is a 12″ clutch, and 150- is a 15″ clutch. The digit between the dashes is the number of driven discs used, i. e., -1- is for a single plate clutch and -2- is for a two-plate clutch. The remaining digits in the model number are the bill of material or parts list numbers used in building the clutch cover plate assembly, i. e., -340 is parts list 340, -308 is parts list 308. The new *serial* numbers are preceded by a letter and have no relation to clutch model or size, i. e., A175, A10960, etc.

2. Illustrations showing the parts of all clutches are shown on pages 17 and 18. Each part is carefully named. When ordering parts, *be sure* to give the name of the part as well as the model number and the serial number of the clutch for which parts are needed. This method of ordering will insure the correct filling of your parts order.

3. Driven disc assemblies are stamped with a model number. When ordering new assemblies give the number stamped on the old assembly or give the outside diameter of the transmission drive shaft and the number of splines thereon and designate whether a rigid or torsional vibration dampener type is desired. Disc assembles are shown on page 19.

Important! Use Only GENUINE LIPE PARTS

CLUTCH ADJUSTMENT

Periodic Inspection

We recommend that the clutch be kept in proper adjustment by periodic inspection of the Dimension "A" which is referred to in Fig. 7 and in the Clutch Adjustment Chart (Pages 6 and 7) in this manual. By so doing, long and satisfactory clutch life will be obtained. *Never wait for a clutch to slip before adjusting it, as it is then too late to make an adjustment.* Once the facings are burned, through slippage, they quickly disintegrate, and are short-lived thereafter. Do not adjust the clutch pedal to restore the original "free travel" (usually 1½"), but instead, pull shims as directed in the following procedure.

❶ Check Dimension "A"
(Clutch Engaged)

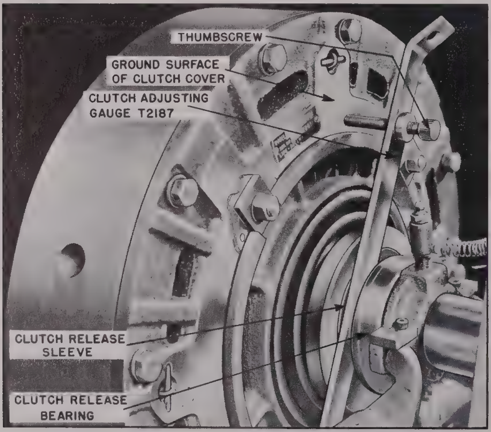

THUMBSCREW
GROUND SURFACE OF CLUTCH COVER
CLUTCH ADJUSTING GAUGE T2187
CLUTCH RELEASE SLEEVE
CLUTCH RELEASE BEARING

FIGURE 2.

With clutch in engaged position, place gauge (T-2187) between face of clutch release sleeve and clutch release bearing. Turn thumb screw of gauge to just contact the ground surface of clutch cover. Dimension "A" is the distance from underside of gauge to end of thumb screw. *NOTE:* Obtain Dimension "A" by adding or removing shims as required. Removing one shim from under each adjusting strap reduces Dimension "A" approximately 3/32". Likewise, adding one shim increases Dimension "A" 3/32".

❷ Block Clutch Pedal
(In Released Position)

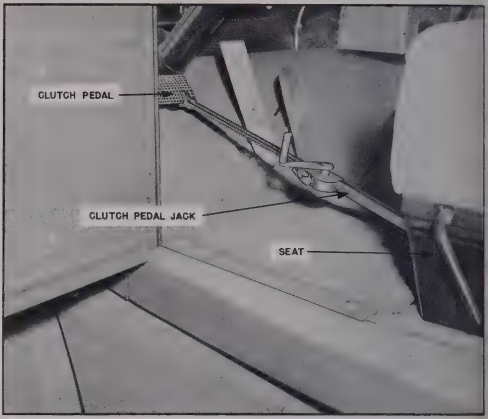

CLUTCH PEDAL
CLUTCH PEDAL JACK
SEAT

FIGURE 3.

Block clutch pedal in released position. This prevents bending of the adjusting straps and facilitates loosening of the adjusting nuts.

❸ Loosen Adjusting Nuts

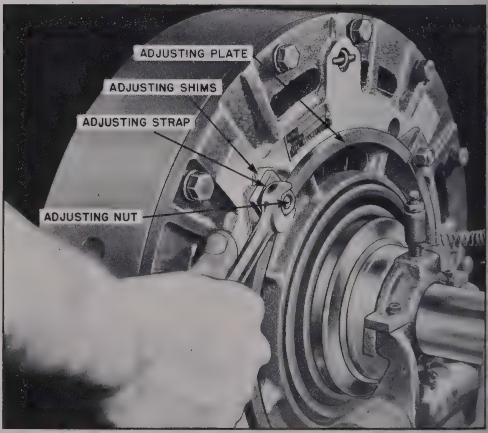

ADJUSTING PLATE
ADJUSTING SHIMS
ADJUSTING STRAP
ADJUSTING NUT

FIGURE 4.

Loosen adjusting nuts 5 full turns.

4 Remove Clutch Pedal Jack

(As shown in Step 2)

Clutch pedal jack is shown in Figure 3. Removing it will allow the adjusting plate to move back for easy removal of shims.

5 Remove Shims

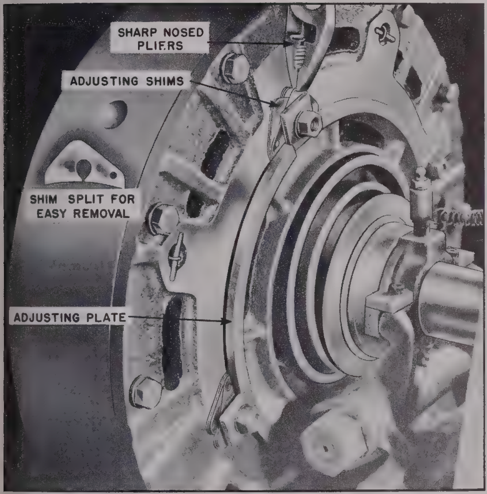

SHARP NOSED PLIERS
ADJUSTING SHIMS
SHIM SPLIT FOR EASY REMOVAL
ADJUSTING PLATE

Figure 5.

(a) To remove shims, use sharp nosed pliers or cotter pin puller.

(b) Removing one shim from each stud reduces Dimension "A" approximately $\frac{3}{32}''$. Likewise, adding one shim increases Dimension "A" $\frac{3}{32}''$.

(c) *CAUTION:* Make sure that an equal quantity of shims remains on each stud before proceeding with Step 6.

6 Reblock Clutch Pedal

(As shown in Step 2)

This is important because it prevents bending of the adjusting straps. It also facilitates the tightening of adjusting nuts.

7 Tighten Adjusting Nuts Firmly

Tighten adjusting nuts, remove pedal jack, and recheck Dimension "A" before proceeding with Step 8.

8 Check Clearance

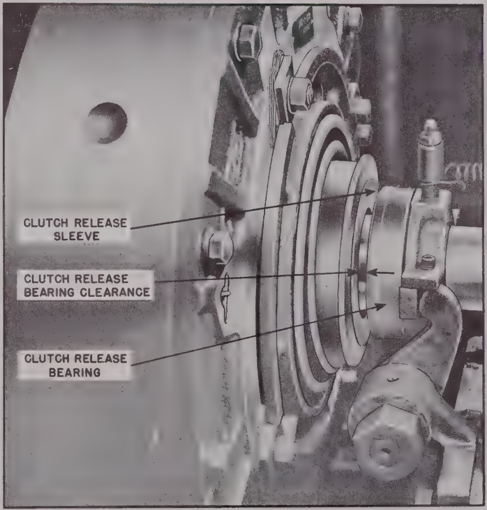

CLUTCH RELEASE SLEEVE
CLUTCH RELEASE BEARING CLEARANCE
CLUTCH RELEASE BEARING

Figure 6.

Check clearance between clutch release sleeve and clutch release bearing.

(a) If clearance is not $\frac{1}{8}''$, adjust vehicle clutch pedal linkage to obtain this $\frac{1}{8}''$ clearance.

(b) This $\frac{1}{8}''$ clearance normally results in $1\frac{1}{2}''$ of clutch pedal "free travel."

Important! Use Only GENUINE LIPE PARTS

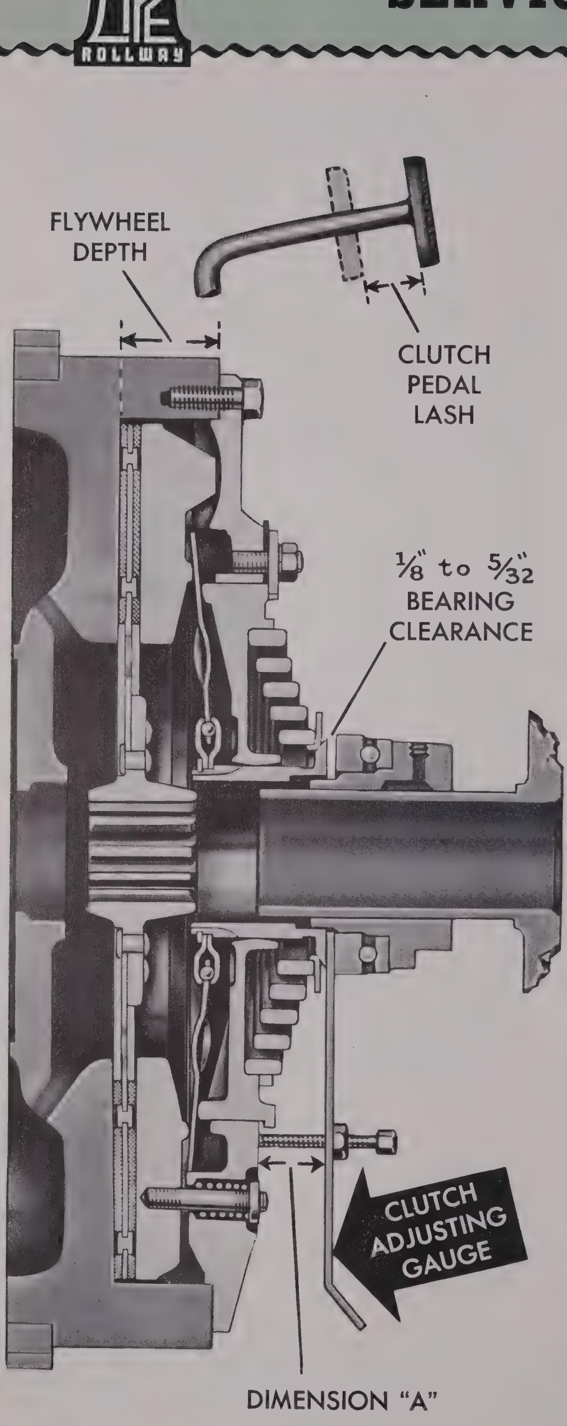


Figure 7. *Dimension "A".*

Model Number	Inch Size	Dimension "A" + 1/16" — 0"	Quantity of Shims	Flywheel Depth	Facing Thickness	Pressure Sprg.
Z22S	12	1"	6	1.920"	5/32"	
Z25SX	14	1 5/16"	8	1.312"	5/32"	
Z27S	13	1 1/16"	8	1.500"	5/32"	
Z28S	14	1 3/16"	8	1.312"	5/32"	
Z29S	14	1 3/16"	8	1.312"	5/32"	
Z29SX	14	1 3/16"	8	1.312"	5/32"	
Z30S	13	1"	6	1.843"	9/64"	
Z31S	14	1 1/4"	6	1.812"	9/64"	
Z32S	14	1 1/16"	6	1.812"	9/64"	
Z33S	15	1 3/8"	6	1.812"	5/32"	
Z33SX	15	1 3/8"	6	1.812"	5/32"	
Z34S	12	1 1/16"	4	1.875"	1/8"	
Z35	13	2 1/8"	6	1.843"	9/64"	
Z37S	13-2	1 5/16"	8	2.937"	1/8"	
Z38S	15-2	1 1/8"	8	2.937"	5/32"	
Z40S	15	1 1/8"	7	1.812"	5/32"	
Z40SX	15	1 1/8"	7	1.812"	5/32"	
Z40S Sp.	15	1 3/8"	13	1.812"	5/32"	
Z42S	15	1 1/8"	7	1.812"	5/32"	
Z42SX	15	1 1/8"	7	1.812"	5/32"	
Z42S Sp.	15	1 3/8"	13	1.812"	5/32"	
Z43S	12	1"	6	1.920"	5/32"	
Z43SX	12	1"	6	1.920"	5/32"	
Z44S	13	1 1/16"	8	1.500"	5/32"	
Z44SX	13	1 1/16"	8	1.500"	5/32"	
Z47S	13-2	1 5/16"	8	2.937"	1/8"	
Z48S	13	1"	6	1.812"	9/64"	
Z54S	14-2	1 1/8"	8	2.937"	9/64"	
Z54SX	14-2	1 3/16"	8	2.937"	9/64"	
120-1-018	12	1"	6	1.920"	5/32"	
130-1-021	13	1 1/16"	8	1.500"	5/32"	
140-1-022	14	1 3/16"	8	1.312"	5/32"	
140-1-023	14	1 3/16"	8	1.312"	5/32"	
130-1-025	13	1"	6	1.843"	9/64"	
140-1-026	14	1 1/4"	6	1.812"	9/64"	
140-1-027	14	1 1/16"	6	1.812"	9/64"	
150-1-028	15	1 3/8"	6	1.812"	5/32"	
130-1-029	13	2 1/8"	6	1.843"	9/64"	
120-1-030	12	1 1/16"	4	1.875"	1/8"	
130-1-033	13	1"	6	1.843"	9/64"	
140-1-038	14	1 1/16"	6	1.812"	9/64"	
120-1-039	12	1 1/16"	4	1.875"	1/8"	
140-1-041	14	1 1/4"	6	1.812"	9/64"	
130-1-043	13	1"	6	1.843"	9/64"	
120-1-044	12	1"	6	1.920"	5/32"	
130-1-045	13	1 1/16"	8	1.500"	5/32"	
130-2-054	13-2	1 5/16"	8	2.937"	1/8"	
130-1-063	13	1"	6	1.812"	9/64"	
140-1-086	14	1 1/16"	6	1.812"	9/64"	
130-1-087	13	1"	6	1.843"	9/64"	
140-1-089	14	1 5/16"	8	1.312"	5/32"	
130-1-092	13	1"	6	1.843"	9/64"	
130-2-096	13-2	1 5/16"	8	2.937"	1/8"	
140-1-102	14	1 1/16"	6	1.812"	9/64"	
130-1-103	13	1"	6	1.843"	9/64"	
120-1-112	12	1"	6	1.920"	5/32"	
140-1-114	14	1 1/4"	6	1.812"	9/64"	
140-1-116	14	1 3/16"	8	1.312"	5/32"	
130-1-117	13	1 1/16"	8	1.500"	5/32"	
140-1-126	14	1 1/16"	6	1.812"	9/64"	
140-1-127	14	1 1/4"	6	1.812"	9/64"	
130-1-128	13	1"	6	1.843"	9/64"	
130-2-132	13-2	1 5/16"	8	2.937"	1/8"	
140-1-138	14	1 1/4"	6	1.812"	9/64"	
150-1-145	15	1 1/8"	7	1.812"	5/32"	

TYPE ML CLUTCHES

	Inch Size	Dimension "A" + 1/16" — 0"	Quantity of Shims	Flywheel Depth	Facing Thickness	Pressure Sprg. Reference No.	Pressure Plate Reference No.
46	15	1 1/8"	7	1.812"	5/32"	4	E
47	15	1 1/8"	7	1.812"	5/32"	6	E
48	15	1 1/8"	7	1.812"	5/32"	4	E
49	15	1 1/8"	7	1.812"	5/32"	8	E
50	15	1 1/8"	7	1.812"	5/32"	13	E
51	15	1 1/8"	7	1.812"	5/32"	15	E
59	15	1 1/8"	7	1.812"	5/32"	8	E
62	15-2	1 1/8"	8	2.937"	5/32"	4	E
63	15-2	1 1/8"	8	2.937"	5/32"	8	E
71	15	1 1/8"	7	1.812"	5/32"	6	E
75	14	1 1/16"	6	1.812"	9/64"	10	K
76	13	2 1/8"	6	1.843"	9/64"	3	F
77	15-2	1 1/8"	8	2.937"	5/32"	4	E
78	15-2	1 1/8"	8	2.937"	5/32"	8	E
79	15-2	1 1/8"	8	2.937"	5/32"	6	E
81	14-2	1 1/16"	8	2.937"	9/64"	4	J
82	14-2	1 1/8"	8	2.937"	9/64"	8	J
87	15	1 1/8"	7	1.812"	5/32"	4	E
91	15	1 3/8"	13	1.812"	5/32"	8	E
92	15	1 3/8"	13	1.812"	5/32"	23	E
93	15	1 3/8"	13	1.812"	5/32"	8	E
95	14	1 1/16"	6	1.812"	9/64"	2	D
99	15	1 1/8"	7	1.812"	5/32"	4	E
200	15	1 1/8"	7	1.812"	5/32"	8	E
226	12	1 1/16"	4	1.875"	1/8"	2	A
227	13	1"	6	1.843"	9/64"	10	F
232	13	1"	6	1.843"	9/64"	10	F
234	14	1 3/16"	8	1.312"	5/32"	4	I
241	15	1 1/8"	7	1.812"	5/32"	4	E
247	15	1 1/8"	7	1.812"	5/32"	13	E
261	15-2	1 1/8"	8	2.937"	5/32"	8	E
266	14	1 3/16"	9	1.187"	9/64"	4	M
287	12	1 1/8"	8	1.875"	5/32"	10	A
293	14	1 1/8"	6	1.812"	9/64"	10	D
295	15	1 3/16"	7	1.812"	5/32"	4	E
300	12	1 1/8"	4	1.875"	1/8"	9	A
301	15	1 3/16"	7	1.812"	5/32"	8	E
302	12	1 1/8"	4	1.875"	1/8"	2	A
307	13	1 1/16"	6	1.812"	9/64"	10	F
308	14	1 5/16"	6	1.812"	9/64"	4	D
310	15	1 3/16"	7	1.812"	5/32"	6	E
311	14	1 1/8"	6	1.812"	9/64"	2	D
312	14	1 5/16"	6	1.812"	9/64"	6	D
314	12	1 1/16"	6	1.920"	5/32"	10	H
315	14	1 1/4"	9	1.187"	9/64"	4	M
316	15	1 3/16"	7	1.812"	5/32"	4	E
317	15	1 3/16"	7	1.812"	5/32"	13	E
318	13	1 1/16"	6	1.843"	9/64"	9	F
319	13	1 1/16"	6	1.843"	9/64"	2	F
320	13	1 1/16"	6	1.843"	9/64"	10	F
321	15-2	1 3/16"	8	2.937"	5/32"	6	E
322	15-2	1 3/16"	8	2.937"	5/32"	4	E
323	15-2	1 3/16"	8	2.937"	5/32"	8	E
326	15	1 3/16"	7	1.812"	5/32"	13	E
327	14-2	1 1/8"	8	2.937"	9/64"	4	J
328	14-2	1 1/8"	8	2.937"	9/64"	8	J
329	15.2	1 3/16"	8	2.937"	5/32"	8	E
330	13-2	1 3/8"	8	2.937"	1/8"	4	C
331	12	1 1/16"	6	1.920"	5/32"	9	A
332	14	1 5/16"	7	1.812"	9/64"	10	I
333	13	1 1/16"	6	1.843"	9/64"	10	F
334	13	1 1/16"	6	1.843"	9/64"	2	B
335	14	1 1/8"	6	1.812"	9/64"	10	K
336	14	1 5/16"	6	1.812"	9/64"	4	K
337	15	1 3/16"	7	1.812"	5/32"	8	E

Model Number	Inch Size	Dimension "A" + 1/16" — 0"	Quantity of Shims	Flywheel Depth	Facing Thickness	Pressure Sprg. Reference No.	Pressure Plate Reference No.
150-1-338	15	1 3/16"	7	1.812"	5/32"	6	E
150-1-339	15	1 3/16"	7	1.812"	5/32"	4	E
120-1-340	12	1 1/8"	4	1.875"	1/8"	10	A
120-1-341	12	1 1/8"	8	1.875"	5/32"	9	A
120-1-342	12	1 1/8"	8	1.875"	5/32"	2	A
150-1-343	15	1 3/8"	15	1.812"	5/32"	23	L
150-1-344	15	1 3/8"	15	1.812"	5/32"	8	L
130-2-347	13-2	1 3/8"	8	2.937"	1/8"	6	C
120-1-359	12	1 1/8"	8	1.875"	5/32"	9	N
120-1-360	12	1 1/8"	8	1.875"	5/32"	2	N
120-1-361	12	1 1/8"	8	1.875"	5/32"	10	N
130-1-362	13	1 1/16"	7	1.843"	5/32"	10	B
150-2-371	15-2	1 3/16"	12	2.937"	5/32"	6	L
150-2-372	15-2	1 3/16"	12	2.937"	5/32"	4	L
150-2-373	15-2	1 3/16"	12	2.937"	5/32"	8	L
140-2-378	14-2	1 1/8"	8	2.937"	9/64"	6	J
150-1-387	15	1 3/16"	10	1.750"	5/32"	8	E
130-41-397	13	1 1/16"	8	1.500"	5/32"	74	F
140-41-400	14	1 3/16"	8	1.312"	5/32"	73	I
130-1-407	13	1 1/16"	8	1.843"	5/32"	10	F
150-2-411	15-2	1 3/16"	12	2.937"	5/32"	8	L
150-41-420	15	1 1/16"	8	1.812"	5/32"	73	E
140-1-425	14	1 1/8"	6	1.812"	9/64"	10	I
150-1-465	15	1 3/16"	7	1.812"	5/32"	8	E
150-1-466	15	1 3/16"	7	1.812"	5/32"	13	E
150-1-467	15	1 3/16"	7	1.812"	5/32"	13	E
150-1-468	15	1 3/16"	7	1.812"	5/32"	8	E
150-2-469	15-2	1 3/16"	12	2.937"	5/32"	8	L
150-2-470	15-2	1 3/16"	12	2.937"	5/32"	8	L
140-2-471	14-2	1 1/4"	8	2.937"	9/64"	8	J
140-1-474	14	1 3/8"	9	1.812"	5/32"	8	D
140-41-475	14	1 1/4"	9	1.812"	5/32"	73	I
140-41-483	14	1 3/16"	8	1.312"	5/32"	73	I
150-41-486	15	1 1/16"	8	1.812"	5/32"	73	E
130-41-487	13	1 1/16"	8	1.500"	5/32"	74	F

★ ★ ★

See Explanation of Table Headings and other Reference Data on next page.

EXPLANATION OF TABLE HEADINGS

MODEL NO.—Is the number stamped on machined surface of the cover, on which adjusting shims are supported, or on the name plate.

INCH SIZE—Refers to the approximate diameter of the driven disc assembly or pressure plate, which determines the clutch size.

DIMENSION "A"—Is the dimension indicated as "A" on the assembly drawing (Fig. 7) and (Fig. 2), and has a limit from plus 1/16" to minus 0".

QUANTITY OF SHIMS—Is the approximate number of adjusting shims required on each stud, to give correct DIMENSION "A". This applies only when the clutch is new in a flywheel of the correct depth and when correct facings are used on the driven disc assembly. This quantity may vary one shim. Fewer shims are required in a used or worn clutch. OBTAIN DIMENSION "A" REGARDLESS OF NUMBER OF SHIMS REQUIRED.

FLYWHEEL DEPTH—Is the correct dimension from the flywheel friction face to the face of the rim. This dimension must not vary more than plus or minus .005".

FACING THICKNESS—Is the correct dimension of each facing on the disc assembly.

PRESSURE SPRING REFERENCE NO.—Is the reference number listed in the chart below to correspond with the LIPE part number.

Reference Number	Lipe Pressure Spring Number	Spring Color	Pounds Minimum Weight
2	C5-2	Yellow	360 Lbs. at 1¼"
3	C5-3	———	360 Lbs. at 2¼"
4	C5-4	Black	480 Lbs. at 1¼"
6	C5-6	Green	440 Lbs. at 1¼"
8	C5-8	Orange & White	575 Lbs. at 1¼"
9	C5-9	Blue	330 Lbs. at 1¼"
10	C5-10	Red	415 Lbs. at 1¼"
13	C5-13	Orange & Blue	630 Lbs. at 1¼"
15	C5-15	Red & Green	400 Lbs. at 1¼"
23	C5-23	Green & White	375 Lbs. at 1¼"
73	C5-73	Brown (Red Wire)	650 Lbs. at 1⅛"
74	C5-74	Orange (Red Wire)	490 Lbs. at 1⅛"

PRESSURE PLATE REFERENCE NO.—Is the reference number listed in the chart below to correspond with the LIPE part number.

Reference Number	Lipe Pressure Plate Number	Distance From Top of Fulcrum Edge to Friction Surface (New)
A	C1-2	.914"
B	C1-3	1.000"
C	C1-6	1.088"
D	C1-7	.975"
E	AC1-9	.977"
F	C1-16	1.013"
G	C1-19	1.026"
H	C1-23	.926"
I	C1-24	.980"
J	AC1-25	1.046"
K	C1-27	.975"
L	AC1-42	.977"
M	C1-61	.918"
N	C1-76	.916"

*—Z38S has a C5-4 pressure spring having a bottom coil diameter of 6¾", or a C5-8 pressure spring having a bottom coil diameter of 7¾".

CLUTCH OVERHAUL

❶ Remove Spring Retainer Pins

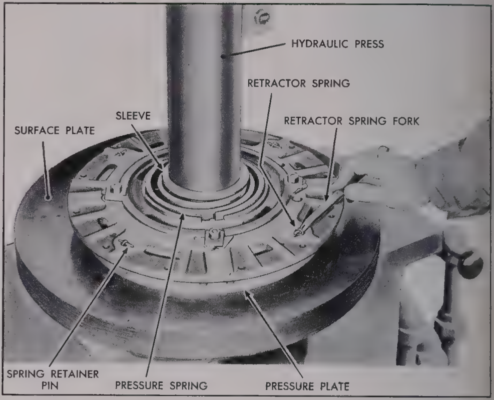


FIGURE 8.

Step (1) Place cover assembly on table of press with assembly resting on pressure plate, and compress the pressure spring as shown. Using a suitable tool, remove the four retractor spring retaining pins, being careful not to overstretch the retractor springs.

❷ Remove Snap Ring

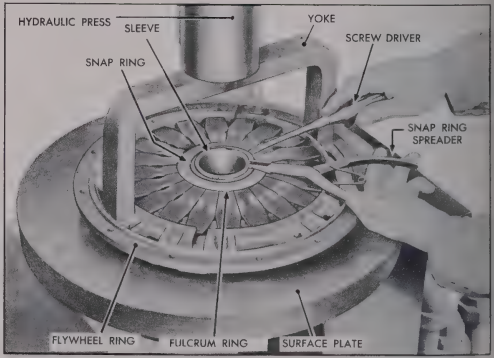


FIGURE 9.

Step (2) Place assembly on table of press with assembly resting on face of release sleeve. Using metal yoke as shown, or suitable blocks of wood, compress the assembly and lock press in position. With the aid of Lipe-Rollway Snap Ring Spreader #T2192, remove the snap ring from groove of sleeve. The fulcrum rings, pressure levers and lever locking balls can now be easily removed.

3 Release the Press

Step (3) *CAUTION: Slowly* release the press. This will allow the pressure spring, sleeve and remaining parts to be removed.

Clutch Tools

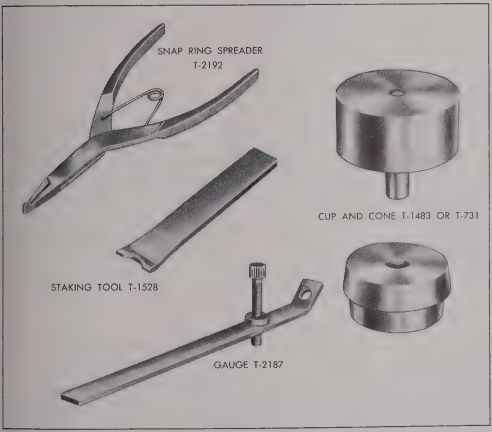


FIGURE 10. *Clutch Overhaul Tools.*

Cup and Cone T731 for use on all 2" bore sleeves (12", 13" and 14" standard single plate clutches.)
Cup and Cone T1483 for use on 2½" bore sleeves (14" heavy duty and 15" Single Plate clutches, also 13", 14", and 15" two-plate clutches.)

Here are shown special tools with which assembly, dis-assembly and adjustment are easily and accurately accomplished.

These tools may be purchased separately. However, it is recommended they be purchased as a complete set to insure the proper size Cup and Cone when needed.

INSPECTION & REPAIR OF COVER ASSEMBLY

After the clutch is disassembled, clean all parts thoroughly with a suitable cleaning solution. Inspect all parts as indicated in the following procedure, but remember this axiom *"IF IN DOUBT, REPLACE WITH A NEW PART."*

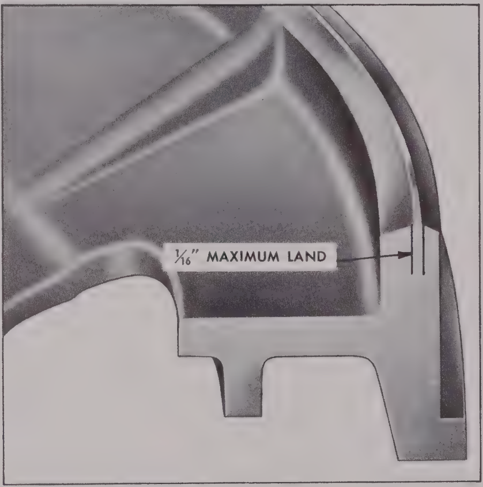


FIGURE 11. *Cross Section View of Fulcrum Edge.*
(Check this on both pressure plate and adjusting plate)

Pressure Plate

(1) Inspect fulcrum edge for excessive wear. Compare fulcrum edge with cross section view of a new fulcrum edge (Fig. 11). If fulcrum edge "land" exceeds 1/16" in width, replace with a new pressure plate. *CAUTION:* Any amount worn from the fulcrum edge directly reduces total available clutch wear.

(2) Inspect friction surface of pressure plate for burning, heat cracking, and distortion. If friction surface is badly scored, heat checked, warped, or dished in excess of .015", replace with a new pressure plate. *CAUTION:* A scored or distorted pressure plate will cause the facings to disintegrate quickly.

Important! Use Only GENUINE LIPE PARTS

Flywheel Ring

(1) Inspect flywheel ring for cracks. If any cracks are visible, replace with a new flywheel ring.

(2) Inspect slots for indentation caused by pressure plate lugs. If indented, replace with a new flywheel ring.

(3) Inspect flange surface for burred edges. *CAUTION:* Burred edges on flange surface should be filed, so as to assure flange being drawn tight to rim of engine flywheel at time of clutch installation.

Adjusting Straps

Inspect adjusting straps for wear and bent condition. If worn or bent, replace with new adjusting straps. *CAUTION:* Worn or bent adjusting straps will prevent proper clamping of adjusting plate to flywheel ring.

Adjusting Plate

(1) Inspect fulcrum edge for excessive wear. Compare fulcrum edge with cross section view of a new fulcrum edge (Fig. 11). If fulcrum edge "land" exceeds 1/16" in width, replace with a new adjusting plate. *CAUTION:* Any amount worn from the fulcrum edge directly reduces total available clutch wear.

(2) Inspect bore for excessive wear. Release sleeve must be a free sliding fit in bore.

(3) Inspect bottom of adjusting strap slots for excessive wear. If wear is indicated, replace with a new adjusting plate. *CAUTION:* Worn slots will prevent proper clamping of adjusting plate to flywheel ring.

Sleeve

(1) Inspect sleeve for excessive wear or indentations of the flange. If wear is indicated, replace with a new sleeve.

(2) Inspect snap ring groove for wear, nicks, or burrs. *CAUTION:* Wear, nicks, or burrs will prevent proper seating of snap ring.

(3) Equalizer sleeve. We suggest that all one piece type sleeves be replaced with our new and improved design equalizer type sleeve and mating spring equalizer ring. See Fig. 12.

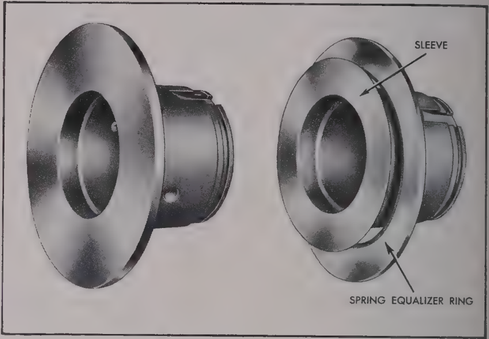


FIGURE 12. *Construction of Release Sleeves.*

Pressure Spring

It is of vital importance that the pressure spring have proper tension. The pressure spring should be checked for compression weight, in accordance with the weights given in the Chart on Pages 6 and 7. *CAUTION:* Underweight springs will cause excessive clutch slippage; therefore, we recommend that a new pressure spring be installed to insure maximum clutch performance.

Fulcrum Rings

Inspect fulcrum rings for wear or warpage. If either worn or warped, replace with new fulcrum rings.

Pressure Levers

Inspect pressure levers to see that they are not bent or excessively worn from contact with fulcrum edges of adjusting plate, pressure plate, and fulcrum rings. If bent or worn, replace with new pressure levers.

Snap Rings and Retractor Springs

Always use a *NEW* snap ring and *NEW* retractor springs when reassembling clutch.

Important! Use Only GENUINE LIPE PARTS

Intermediate Plate and Driving Pins

(1) Inspect friction surfaces of intermediate plate for heat cracks, scoring, and distortion. If warped, heat checked, or scored, replace.

(2) Inspect driving slots of intermediate plate for wear. If worn, replace. Refer to intermediate plate and driving pin clearance on Page 16.

(3) Inspect driving pins. If worn, replace.

INSPECTION & REPAIR OF DISC ASSEMBLY

Inspect disc assembly for cracks, worn splines, and warped or dished condition. If any of these conditions exist, replace with a new disc assembly. If it is decided the disc assembly is refaceable, refer to Page 14 for correct refacing procedure.

CLUTCH ASSEMBLY

① Install Clutch Adjusting Plate and Shims

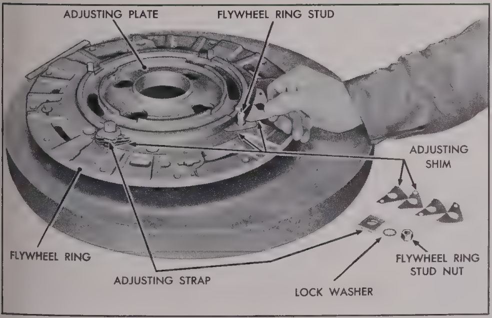

ADJUSTING PLATE
FLYWHEEL RING STUD
ADJUSTING SHIM
FLYWHEEL RING
ADJUSTING STRAP
LOCK WASHER
FLYWHEEL RING STUD NUT

FIGURE 13.

Assemble adjusting plate to flywheel ring. Install clutch adjusting shims, using the number of shims required on each stud to obtain the proper Dimension "A". See chart on page 6.

② Install Pressure Spring In Adjusting Plate and Assemble to Sleeve

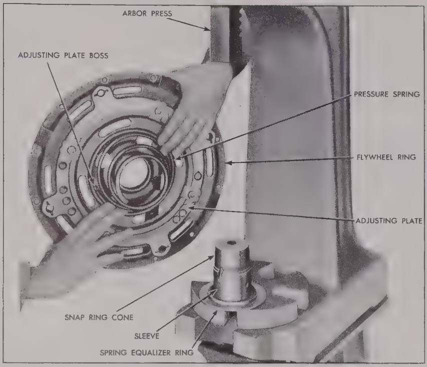

ARBOR PRESS
ADJUSTING PLATE BOSS
PRESSURE SPRING
FLYWHEEL RING
ADJUSTING PLATE
SNAP RING CONE
SLEEVE
SPRING EQUALIZER RING

FIGURE 14.

Place sleeve on arbor press with face down. Set equalizer ring over sleeve onto beveled edge of sleeve flange with flat side of ring down. Insert cone portion of the snap ring assembling tool (see page 8) in the end of the sleeve. Place pressure spring on adjusting plate with end of large coil abutting the small boss in the adjusting plate. Place flywheel ring, adjusting plate, and pressure spring assembly over the sleeve, seating the small coil of spring in position on spring equalizer ring.

③ Compress the Assembly

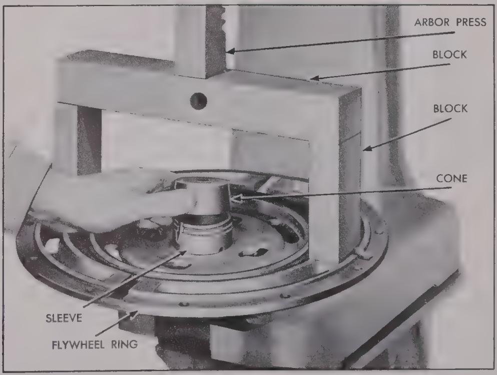

ARBOR PRESS
BLOCK
BLOCK
CONE
SLEEVE
FLYWHEEL RING

FIGURE 15.

Using block system illustrated, compress slowly the assembly to allow the sleeve to slip through the bore of the adjusting plate. Lock the press and remove the coned tool. *CAUTION:* Be sure equalizer ring is seated properly on top coil of pressure spring.

4 Install Fulcrum Ring

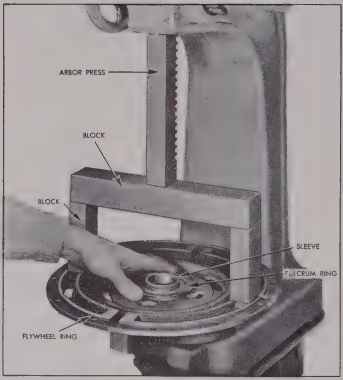

ARBOR PRESS
BLOCK
BLOCK
SLEEVE
FULCRUM RING
FLYWHEEL RING

FIGURE 16.

Place one of the fulcrum rings, cupped side up, over the sleeve until it is seated firmly.

5 Arrange Levers

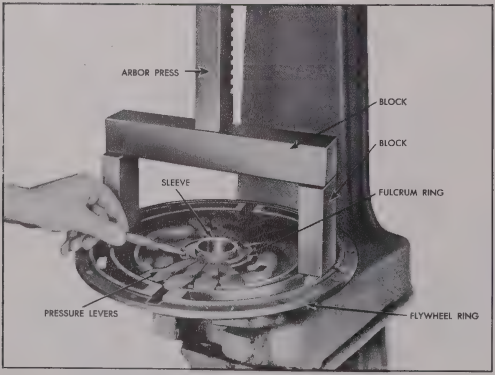

ARBOR PRESS
BLOCK
BLOCK
SLEEVE
FULCRUM RING
PRESSURE LEVERS
FLYWHEEL RING

FIGURE 17.

Arrange the twenty pressure levers around the sleeve, as illustrated.

6 Install Lever Locking Balls

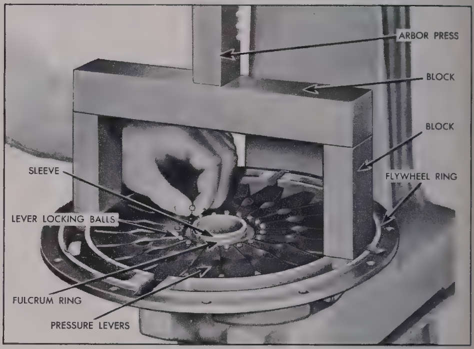

ARBOR PRESS
BLOCK
BLOCK
SLEEVE
FLYWHEEL RING
LEVER LOCKING BALLS
FULCRUM RING
PRESSURE LEVERS

FIGURE 18.

Using lever locking balls of proper size, insert one in the hole at the end of each lever.

7 Install Fulcrum Ring

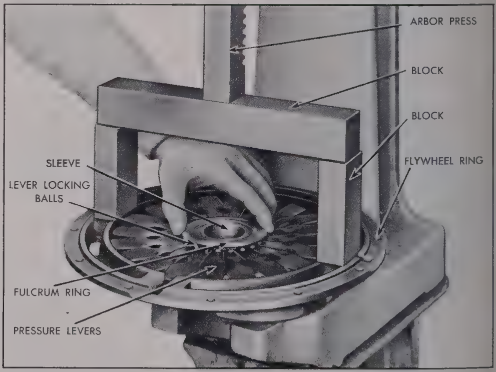
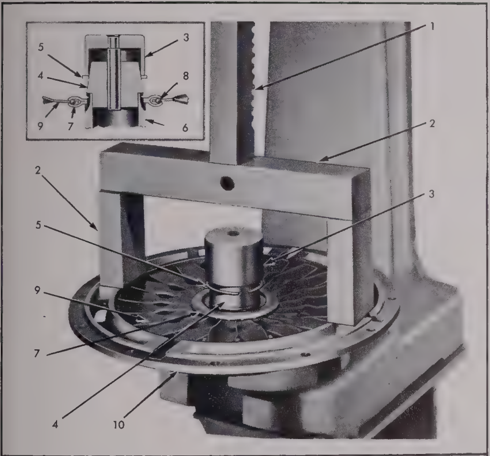

ARBOR PRESS
BLOCK
BLOCK
SLEEVE
FLYWHEEL RING
LEVER LOCKING BALLS
FULCRUM RING
PRESSURE LEVERS

FIGURE 19.

Place other fulcrum ring, cupped side down, over sleeve, making sure levers do not overlap.

⑧ Install Clutch Snap Ring


1
2
3
4
5
6
7
8
9
10
5
3
4
8
9
7
6
2
5
9
7
4
10
3

1. Arbor Press
2. Blocks
3. Cup
4. Cone
5. Snap Ring
6. Sleeve
7. Fulcrum Ring
8. Lever Locking Balls
9. Pressure Levers
10. Flywheel Ring

Figure 20.

Reinsert coned tool into sleeve and set *NEW* snap ring over coned tool with open ends of snap ring at right angles to keyways of the sleeve. Place cupped tool on snap ring and tap until snap ring is seated into groove of sleeve.

⑨ Lock Clutch Snap Ring

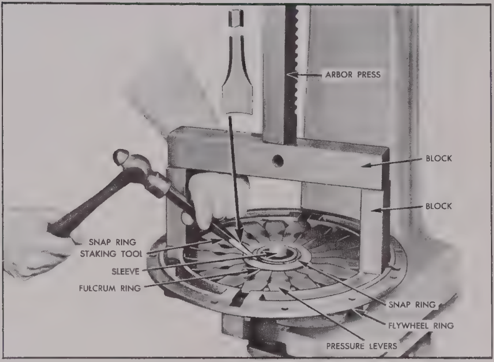

ARBOR PRESS
BLOCK
BLOCK
SNAP RING STAKING TOOL
SLEEVE
FULCRUM RING
SNAP RING
FLYWHEEL RING
PRESSURE LEVERS

Figure 21.

Remove cup and cone from sleeve and with the snap ring staking tool (see Page 8) starting opposite the open ends of the snap ring, work each way until snap ring is seated well into groove of sleeve.

CAUTION: Test each of the twenty levers to see that they are locked securely by a ball and that they do not overlap. Release the press and remove the blocks.

⑩ Install Retractor Springs On Pressure Plate and Assemble to Cover

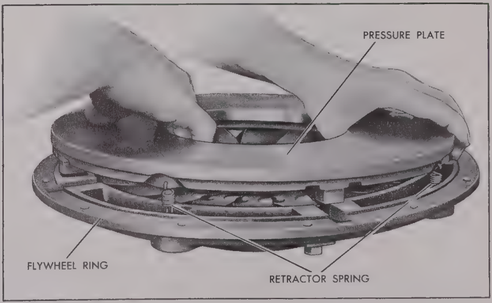

PRESSURE PLATE
FLYWHEEL RING
RETRACTOR SPRING

Figure 22.

Hook the four retractor springs in pressure plate. Place pressure plate and springs in position on assembly with driving lugs of pressure plate fitting into driving slots of flywheel ring. The driving lugs should fit free in the slots of the flywheel ring with a clearance of .004″ to .006″. If original pressure plate is used, reassemble with driving lug marked "0" in driving slot marked "0". Turn assembly over and compress on arbor press to facilitate installing retainer pins in retractor springs. This will prevent spring from becoming over-stretched.

NOTE: With the exceptions of the 15″ single-plate and 14″-15″ two-plate cover plate assemblies, follow steps 1-11 as shown here. For these 3 sizes, follow steps 1-10 on these pages and THEN follow steps 11a and 11b as described.

11 Install Spring Retainer Pins

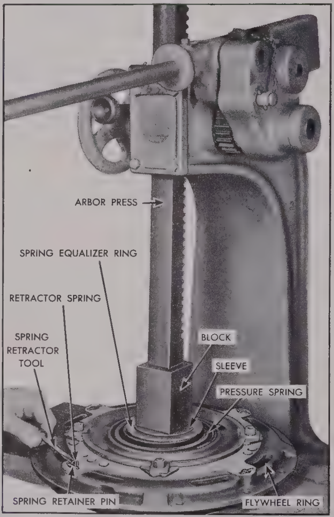


FIGURE 23.

Insert retractor spring pins through hook of springs as illustrated.

11a (See italicized note above.) With assembly resting on its sleeve, install pressure plate and stud assembly in position with driving lugs of pressure plate fitting in driving slots of flywheel ring. If original pressure plate is used, assemble with driving lug marked "0" in driving slot marked "0". Turn assembly over and compress on arbor press, allowing for easier insertion of retainer pins.

11b (See italicized note above.) Place the four retractor springs over the pressure plate studs and into the recesses in flywheel ring. Set the retainer washers in position over each spring and compress far enough to permit the insertion of the retainer pins in holes at ends of studs. The retainer washers should have cupped side up so as to lock the retainer pins in position.

Note: Intermediate plate separator springs are no longer specified. We recommend that they be removed.

REFACING DISC ASSEMBLY

(1) When refacing, it is extremely important that you use GENUINE Lipe parts. Replacement parts do not possess the proper materials to insure good performance.

(2) Make sure the facings used are of the proper thickness. See chart on pages 6 and 7.

(3) The disc must be free of all cracks and foreign matter. Never reface a warped or dished disc.

(4) Figs. 25a and 25b illustrate the importance of proper riveting. Fig. 25a shows the correct method of riveting, using a star set anvil, resulting in the split end of the rivet conforming to the tapered counterbore of facing. The rivet is seated firmly, thereby eliminating loose facings on the disc. Fig. 25b shows the incorrect method of riveting, using a roll or eyelet anvil, resulting in small contact area on split end of rivet, and damage to the facing. This type riveting will result in the facing working loose, as the rivets are not seated firmly.

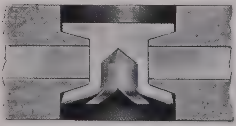


FIGURE 25a.
Correct Riveting.

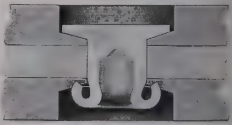


FIGURE 25b.
Incorrect Riveting.

PRECAUTIONS IN ASSEMBLING CLUTCH

- Make sure large coil of spring has its end located at left of small boss (stop) on adjusting plate.

Remove any burrs in bore of adjusting plate or on release sleeve. Sleeve must be a "free fit" in adjusting plate.

Make sure the pressure spring meets the correct compression weight in accordance with the weights given in Clutch Adjustment Chart (Pages 6 & 7).

When ready to assemble balls in levers, be sure that a ¼″ diameter ball is used in 12″, 13″ and 14″ standard single-plate clutches, and a 9/32″ diameter ball is used in the 14″ heavy duty single-plate, 15″ single-plate and 13″, 14″ and 15″ two-plate assemblies.

Always use *new* snap ring when rebuilding and be sure it is firmly seated in its slot by tapping the ring home.

Test each lever after assembly to make sure it has a ball locking it in the fulcrum rings.

On the 12″, 13″ and 14″ single-plate and the 13″ two-plate assemblies, the tension type retractor springs are used. Be sure the coils of the spring fit closely together. If such is not the case, the springs should be replaced with new ones. The 15″ single-plate and the 14″ and 15″ two-plate assemblies use a compression type spring and the coils should be open.

Pressure plate must be free in slots of flywheel ring. Approximately .004″-.006″ looseness must be provided. If old plate is used, assemble the "0" marked lug in the "0" marked slot of the flywheel ring.

If new facings have been assembled to the driven disc or a new disc is used, make sure the required number of shims are located under each adjusting strap (see chart, Page 6).

CLUTCH INSTALLATION

Inspect Engine Flywheel

(1) Check flywheel for correct depth. See chart on pages 6 & 7.

(2) Make sure release bearing and flywheel or pilot bearing are in usable condition. Pilot bearing should be a finger press fit in flywheel and on transmission drive shaft.

(3) Friction face of flywheel should be smooth and clean. *CAUTION:* The friction face of the flywheel must be free from heat cracks, score marks, and foreign matter, as the presence of any one of these conditions will cause the facings to quickly disintegrate.

Installing Single-Plate Clutch Assembly

(1) Try cover plate assembly in flywheel before inserting driven disc assembly, so as to make sure it is a free fit in the flywheel.

(2) Install driven disc assembly in the flywheel.

(3) Bolt the clutch assembly to the flywheel and screw in each bolt until it contacts cover plate assembly. Then gradually tighten opposite bolts until assembly is drawn tight to flywheel.

(4) Check for proper Dimension "A". See chart on pages 6 & 7.

(5) Care should be used in installing the transmission to prevent bending or otherwise impairing the disc assembly which will cause clutch drag.

Important! Use Only GENUINE LIPE PARTS

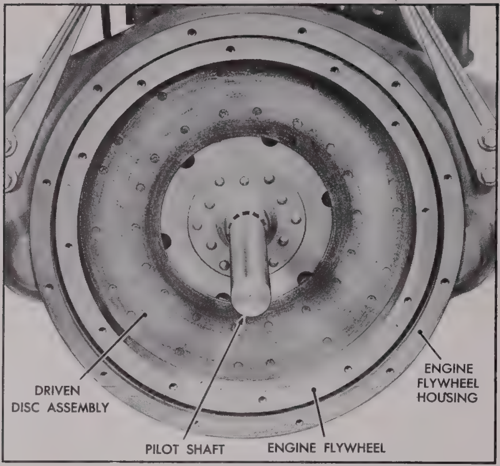


FIGURE 26. *Use of Pilot Shaft in Installing Clutch.*

(6) To facilitate the assembly of the transmission to the engine, the use of a spare splined pilot shaft (Fig. 26) to align the driven disc assembly while bolting the clutch in place is essential. The pressure plate end of the driven disc assembly hub has been chamfered to facilitate the insertion of the drive shaft, whereas the flywheel end of the hub is left plain.

Installing Two-Plate Clutch Assembly

(1) Inspect the four intermediate plate driving pins in flywheel. *Make certain that shanks of pins are press fitted into flywheel rim, and that the heads are squarely aligned with the friction face. NOTE:* To facilitate the alignment of the driving pins we refer you to Fig. 27 which illustrates intermediate plate driving pin alignment gauge #T9188 in use.

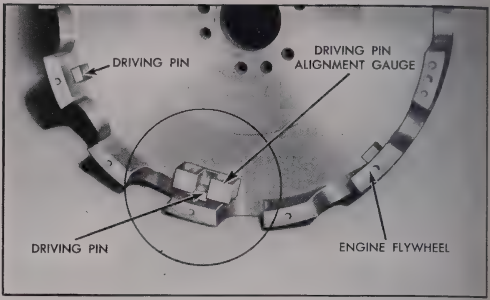


FIGURE 27. *Driving Pin Alignment Gauge.*

(2) Make sure there is clearance between heads of driving pins and driving slots in intermediate plate by placing intermediate plate over pins. *NOTE:* The intermediate plate should fit over the driving pins with perceptible circumferential lash before the clutch is assembled to the engine flywheel. A clearance of .007″ to .011″ is required.

(3) The 13″ two-plate clutch assembly incorporates retractor spring pins to retract the intermediate plate when clutch is released. This necessitates the driven disc assembly next to the pressure plate being in place before the intermediate plate is assembled to the cover plate assembly.

(4) Install the driven disc assemblies and intermediate plate as follows: (A) Install the disc assembly marked "flywheel side" next to the friction face of the flywheel, with the marking next to the flywheel friction face. (B) Install the intermediate plate. *CAUTION:* Make certain that the intermediate plate's rotation is in the direction shown by the arrows appearing on one side of the plate near the bore. (C) Install the disc assembly marked "pressure plate side" next to the friction surface of the clutch pressure plate, with the marking next to the pressure plate friction face.

(5) Bolt clutch cover plate to flywheel. Screw in each bolt until it contacts the cover plate. Then gradually tighten opposite bolts until assembly is drawn tight to flywheel.

(6) Check for proper Dimension "A". See chart on pages 6 & 7.

(7) Care should be used in installing the transmission, to prevent bending or otherwise impairing the disc assemblies which will cause clutch drag.

(8) To facilitate the assembly of the transmission to the engine, the use of a spare splined pilot shaft (Fig. 26) to align the driven disc assemblies while bolting the clutch in place is essential.

Cutaway Drawing Showing Detail of Lipe Single-plate Clutches

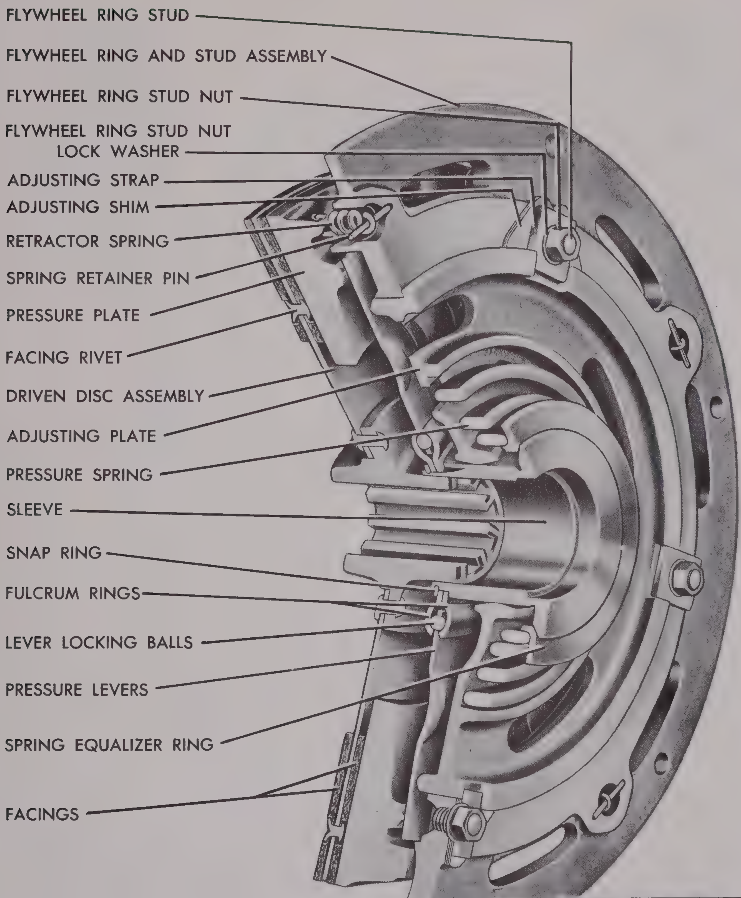

FLYWHEEL RING STUD
FLYWHEEL RING AND STUD ASSEMBLY
FLYWHEEL RING STUD NUT
FLYWHEEL RING STUD NUT LOCK WASHER
ADJUSTING STRAP
ADJUSTING SHIM
RETRACTOR SPRING
SPRING RETAINER PIN
PRESSURE PLATE
FACING RIVET
DRIVEN DISC ASSEMBLY
ADJUSTING PLATE
PRESSURE SPRING
SLEEVE
SNAP RING
FULCRUM RINGS
LEVER LOCKING BALLS
PRESSURE LEVERS
SPRING EQUALIZER RING
FACINGS

FIGURE 28. *Sectional view of single-plate clutch construction*

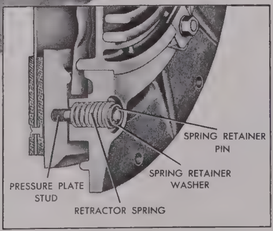

SPRING RETAINER PIN
SPRING RETAINER WASHER
PRESSURE PLATE STUD
RETRACTOR SPRING

FIGURE 28a. *Sectional view showing difference in construction of pressure plate retractor spring on 15" single-plate clutch.*

Cutaway Drawing Showing Detail of Lipe Two-Plate Clutches

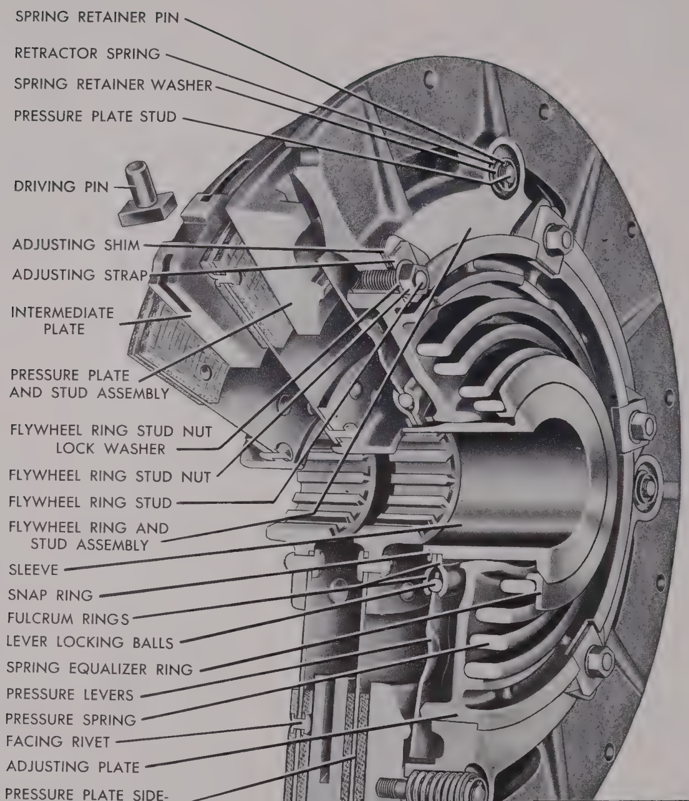

SPRING RETAINER PIN
RETRACTOR SPRING
SPRING RETAINER WASHER
PRESSURE PLATE STUD
DRIVING PIN
ADJUSTING SHIM
ADJUSTING STRAP
INTERMEDIATE PLATE
PRESSURE PLATE AND STUD ASSEMBLY
FLYWHEEL RING STUD NUT LOCK WASHER
FLYWHEEL RING STUD NUT
FLYWHEEL RING STUD
FLYWHEEL RING AND STUD ASSEMBLY
SLEEVE
SNAP RING
FULCRUM RINGS
LEVER LOCKING BALLS
SPRING EQUALIZER RING
PRESSURE LEVERS
PRESSURE SPRING
FACING RIVET
ADJUSTING PLATE
PRESSURE PLATE SIDE-DRIVEN DISC ASSEMBLY
FLYWHEEL SIDE DRIVEN DISC ASSEMBLY
FACINGS
RETRACTOR SPRING

FIGURE 29. *Sectional view of two-plate clutch construction.*

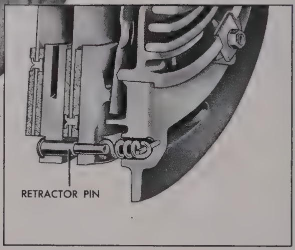

RETRACTOR PIN

FIGURE 29a. *Sectional view showing difference in construction of pressure plate retractor spring and pin on 13″ two-plate clutch.*

Important! Use Only GENUINE LIPE PARTS

Types of Driven Disc Assemblies

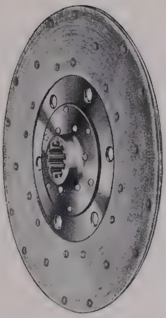


FIGURE 30. *Rigid Type.*

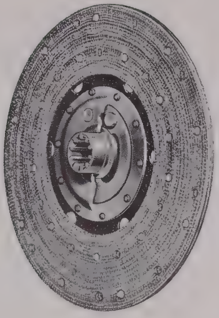


FIGURE 30a. *Dampener Type.*

. . . A WORD ABOUT GENUINE LIPE PARTS

If any repair work should ever become necessary on Lipe clutches, be sure to specify *genuine* Lipe parts. Here's why:

> **You can be sure that Lipe parts will work right. They'll work right because they're made right—by the most modern and efficient methods known. Only the finest quality materials are used. Workmanship and materials are checked and rechecked all along the line . . . all to assure you that Lipe parts will do the job as it should be done. *Be sure!* Use only genuine Lipe parts.**

Important! Use Only GENUINE LIPE PARTS

LIPE
ROLLWAY

. . . Your Symbol of Quality

COOLING SYSTEM

Caution: Based on the fire hazard and insurance regulations, we do not recommend the use of gasoline when cleaning parts. A less inflammable fluid should be used such as kerosene or any noninflammable commercial cleaning solvent.

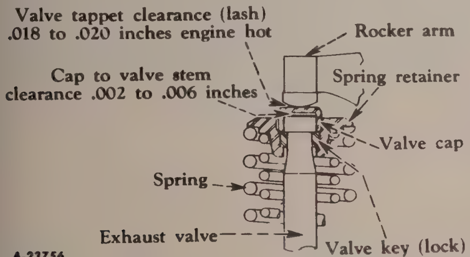
Overhauling

Consult an International Service Station or an authorized dealer before attempting a general overhauling.

Cleaning the Engine

The importance of having an engine, or any other unit in the truck, clean and free from dirt, sludge, abrasives, etc., cannot be too strongly stressed.

Slo-Roto Exhaust Valve

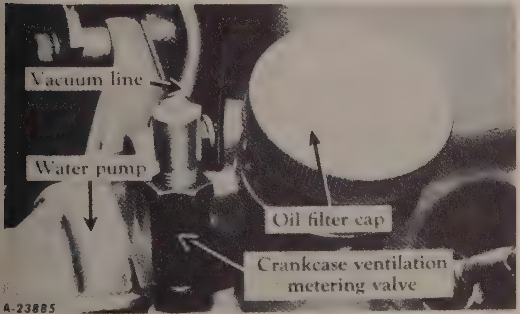

Valve tappet clearance (lash)
.018 to .020 inches engine hot
Rocker arm
Cap to valve stem
clearance .002 to .006 inches
Spring retainer
Valve cap
Spring
Exhaust valve
Valve key (lock)

A-23756

Slo-Roto exhaust valve mechanism.

The slo-rotating mechanism is used on the exhaust valves only and greatly extends the service life of the valves. To retain the efficiency of this mechanism it is imperative that the recommended clearances be maintained *as shown in the above illustration.*

Crankcase Ventilation


Vacuum line
Water pump
Oil filter cap
Crankcase ventilation
metering valve

A-23885

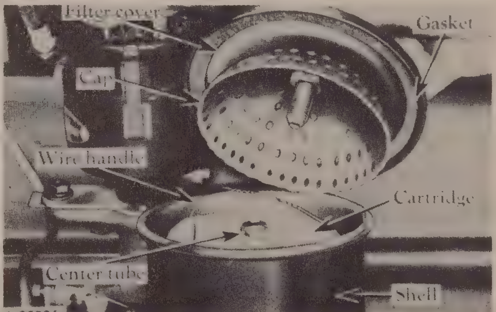
To retard the accumulation of harmful substances in the engine crankcase, positive ventilation of the crankcase has been provided. The ventilator metering valve shown above maintains positive air flow through the engine crankcase at all engine speeds. A rubber hose connecting the engine valve cover to the engine air cleaner supplies dust-free air for crankcase ventilation. The engine air cleaner should be serviced *according to the lubrication instructions* to maintain crankcase ventilation at a maximum efficiency.

Oil Filter

Proper maintenance will enable the oil filter to retard the engine oil contamination and prevent damage to the engine by removing harmful abrasives. The cartridge should be replaced when the oil has darkened.

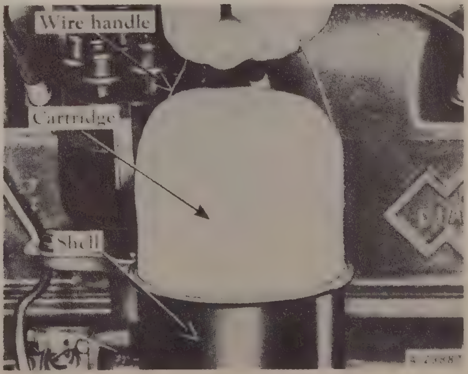
Be sure the sediment in the sump at the bottom of the filter cartridge is thoroughly cleaned before inserting the new cartridge. Do not fail to read the printed instructions on the box containing the new filter cartridge.

Install the new cartridge, replace the cover and tighten the screw top. Start the engine and allow it to run for at least ten minutes to fully saturate the new filter cartridge. Shut off the engine and check the filter thoroughly for leaks. Also check the oil level. Use finger pressure only to tighten the screw top.


Filter cover
Gasket
Cap
Wire handle
Cartridge
Center tube
Shell

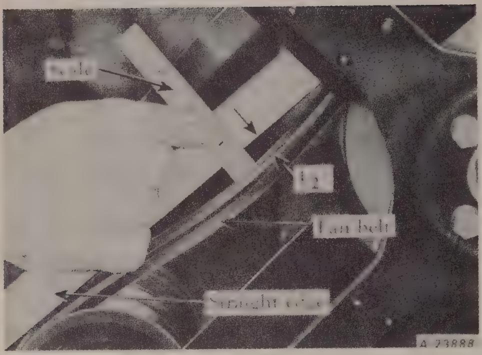
A-23886

Loosen the screw top and remove the filter cover.


Wire handle
Cartridge
Shell

Use the wire handle on the cartridge to lift out the used cartridge from the filter body.

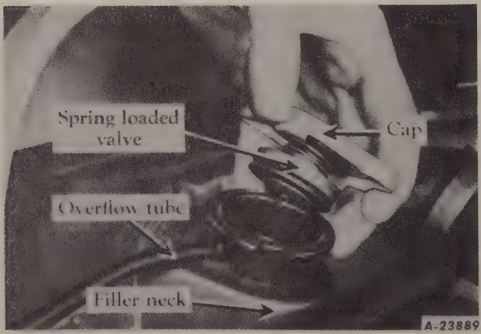
Fan Belt



The tension of the fan belt should be examined periodically. The proper tension is obtained when the belt can be depressed approximately 1/2 inch on the center of the section between the fan pulley and the generator.

To adjust the belt, loosen the generator mounting cap screws and the generator brace cap screw, then move the generator in or out as required. After adjustment has been made, be sure to tighten the cap screws.

Radiator Cap



The radiator cap is the pressure-sealing type. Its purpose is to hold the cooling system under a slight pressure, increasing the boiling point of the cooling solution and preventing loss of the solution due to evaporation and overflow.

The cap has a spring-loaded valve, the seat of which is below the overflow pipe in the filler neck. This prevents the escape of air or liquid while the cap is in position. When the cooling system pressure reaches a predetermined point, the cap valve opens and will again close when the pressure drops below the predetermined point.

When removing the pressure type cap from the radiator, perform the operation in two steps. Loosening the cap to its first notch raises the valve from the gasket and releases the pressure through the overflow pipe. In the first stage position of the cap it should be possible to depress the cap approximately 1/8 inch. The prongs on the cap can be bent to adjust this condition. Care must be taken that the cap is not too loose as this would prevent proper sealing.

Caution: In removing the cap, loosen it slowly and then pause a moment. This will avoid possible burning by hot water or steam. Then continue to turn the cap to the left until you can remove it.

Cleaning the Cooling System

Twice a year or more often, depending upon the kind of cooling water used, the cooling system should be drained and thoroughly flushed. This is particularly important before using an antifreeze solution.

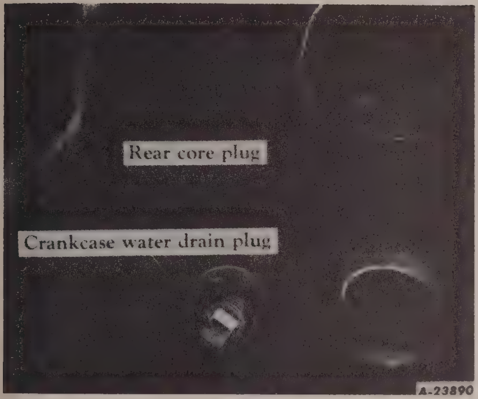
Unless the cooling water is treated with a corrosion preventive, rust and scale will eventually clog up passages in the radiator and water jackets. This condition is aggravated in some localities by the formation of insoluble salts from the water used.

Cleaning solutions are available which have proven very successful in removing the accumulation of rust, scale, sludge and grease. This solution should be used according to the manufacturer's recommendation.

Note: Do not use chemical mixtures to stop radiator leaks except in an emergency. Never use such solutions instead of needed radiator repair.

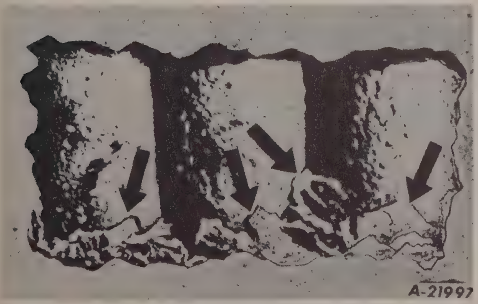
If no commercial cleaning solution is available, dissolve about four pounds of ordinary washing soda in sufficient water to fill the cooling system. Leave the radiator filler cap off and run the engine for about one-half hour or until the engine gets hot. Then drain and flush thoroughly with clean water.

Cleaning the Cooling System-Continued



When draining the cleaning solution, disconnect the radiator outlet hose as large particles of sediment will not pass through the drain cock. Also remove the drain plug on the right side of the crankcase at the rear of the engine.

If the radiator is clogged with insoluble salt formations, it should be taken to a reputable concern specializing in the removal of such formations. Reliable radiator service stations are familiar with local conditions and are equipped to apply the proper treatment.



Rust and corrosion accumulation.

The condition of extreme rust clogging illustrated, is convincing proof that the practice of flushing the system by forcing water from a hose in the radiator filler neck, without the use of cleaning solutions, may be only a waste of time. Iron corrosion is greater than that of any other cooling system metal, which accounts for the large quantities of rust found in neglected water jackets. Heavy rust deposits in the water jacket hold in heat and create local hot spots, especially around the exhaust valve seats. Under these conditions, the metal may get so hot that the valves will stick or burn, or the cylinder block or head may be damaged by heat cracking.

Rust Prevention

One of the common causes of engine overheating is a rust-clogged cooling system. Rust interfers with circulation and cooling, causing overheating.

Rust and corrosion formation can be prevented by maintaining full strength corrosion protection at all times.

A rust preventive or inhibitor should be added to the cooling system for protection against corrosion during warm weather operation. For cold weather operation, replace the inhibitor solution with a chemically treated antifreeze solution.

Thermostat

The thermostat is the nonadjustable type and is incorporated in the cooling system for the purpose of retarding or restricting circulation of water or coolant to achieve rapid engine warm-up. The thermostat is mounted in the cylinder head water outlet, just above the water pump.

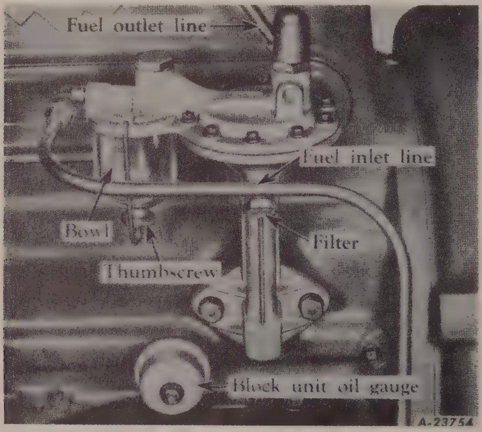
Engine overheating and loss of coolant is sometimes due to a defective thermostat. When thorough inspection seems to indicate this condition exists, check the thermostat with an accurate high temperature thermometer by submerging in hot water.

Fuel Pump

The fuel pump should be thoroughly cleaned. Periodically check the fuel pump bowl for dirt, moisture and rust accumulation. The sediment bowl and filter element or screen are provided to prevent the entry of these troublesome elements into the carburetor and thus cause engine failure.

AC Type Fuel Pump

To clean, loosen the thumbscrew at the bottom of the fuel pump bowl. Remove the bowl and filter element or screen, and wash the bowl in kerosene. Loosen the two knurled nuts on the fuel filter element; this allows the individual discs to be slightly separated from each other so that all the dirt can be blown from the element with a blast of air. After cleaning the filter element, tighten the knurled nut finger tight. Do not use a wrench or pliers.


Fuel outlet line
Fuel inlet line
Bowl
Filter
Thumbscrew
Block unit oil gauge
A-23754

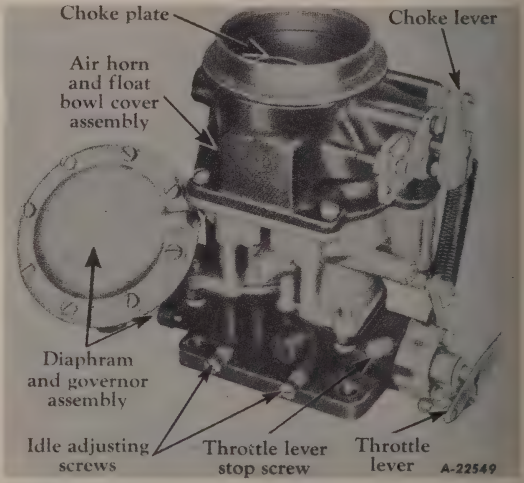
When assembling, be sure the cork gasket is in place and that the thumbscrew is tight. Before a new gasket is used, soak it in light engine oil. A leak at the gasket will cause erratic action of the pump and thus retard delivery of fuel to the carburetor.

Carburetor

When excessive gas consumption or inefficient engine performance is encountered, care should be exercised in determining the exact cause before assuming the carburetor to be at fault. Engine compression, valve clearance, ignition timing, defective wiring, improperly spaced or fouled plugs, distributor contact points, condenser, coil and fuel pump are all factors to be considered and must be within the limits specified by the manufacturer to secure maximum gas mileage.

Due to the technical knowledge and skill required and the special equipment needed to make the necessary tests and corrections, we recommend the work be done by an International Service Station or authorized dealer.

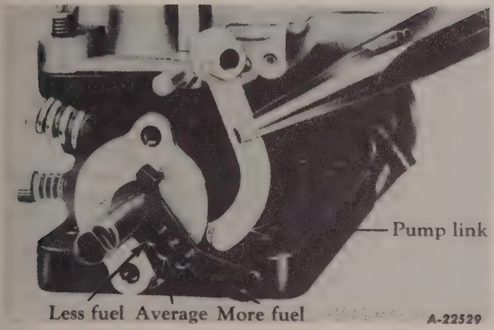
HOLLEY CARBURETOR


Choke plate
Choke lever
Air horn and float bowl cover assembly
Diaphram and governor assembly
Idle adjusting screws
Throttle lever stop screw
Throttle lever
A-22549

Red Diamond Engines 406

Note: Always clean the parts to be worked on so as to be sure no dirt enters the fuel system. Use cleaning solvent or kerosene. Do not use gasoline.

Holley Carburetor - Continued

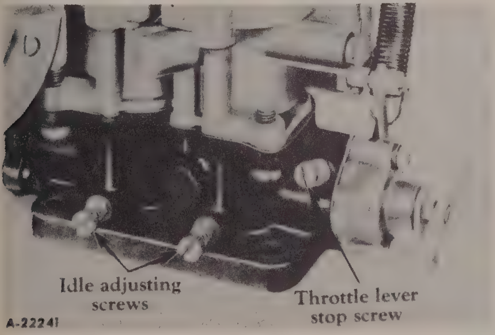

Pump link
Less fuel
Average
More fuel
A-22529

Accelerating pump stroke adjustment.

The above illustration shows the throttle control lever housing removed to illustrate the adjustable stroke setting in the throttle control lever. Normally the housing need not be removed to make this adjustment.

The accelerating pump has an adjustment for varying the quantity of the accelerating charge. Adjustment is made by changing the position of the pump link in the holes of the operating lever. The No. 1 position is for summer or hot weather setting; this delivers the smallest quantity of fuel for acceleration. The No. 2 position is for the average setting. The No. 3 position is for winter or cold weather setting; this delivers the greatest quantity of fuel for acceleration.

Idling Speed Adjustment


Idle adjusting screws
Throttle lever stop screw
A-22241

Start the engine and run it until thoroughly warm.

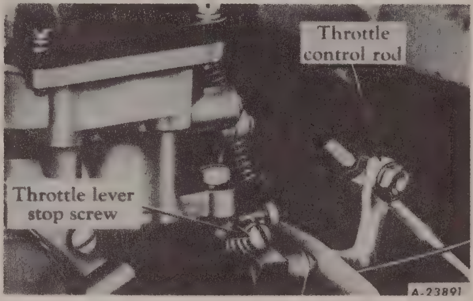
Close the throttle and set the throttle lever stop screw so that the engine will run sufficiently fast to keep it from stalling.

Turn in or out on the idle adjusting screws until the engine fires evenly and without galloping or skipping.

Then back off on the stop screw until the desired idling speed is obtained.

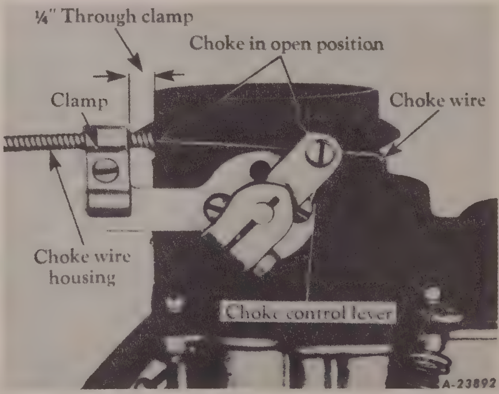
Note: If a vacuum gauge is used for adjustment, adjust the idle adjusting screws to obtain the highest steady vacuum reading.

Throttle Lever Control Rod


Throttle control rod
Throttle lever stop screw
A-23891

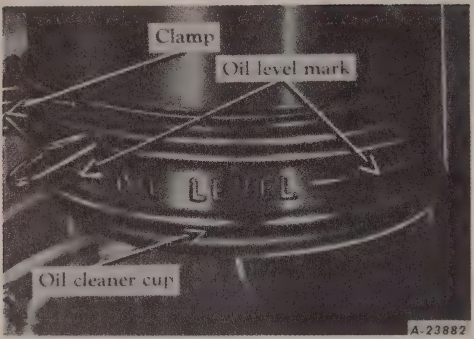
The throttle lever control rod adjustment provides positive return of the throttle lever to the throttle lever stop screw. Adjust the throttle lever swivel on the linkage to obtain positive return of the throttle lever to the stop screw when the accelerator is released to the idle position.

Carburetor Choke Control


¼" Through clamp
Choke in open position
Clamp
Choke wire
Choke wire housing
Choke control lever
A-23892

It is of the utmost importance that the carburetor choke control wire be properly positioned in the swivel linkage on the carburetor to prevent needless waste of fuel. When making an adjustment of the choke linkage, be sure sufficient clearance is maintained between the choke lever and the end of the choke wire housing to permit a fully closed choke.

Air Cleaner (Oil bath type)


Clamp
Oil level mark
OIL LEVEL
Oil cleaner cup
A-23882

To maintain cleaner efficiency whenever the oil in the air cleaner should be changed chassis is lubricated, or more often under severe dust conditions. Remove the air cleaner oil cup. Clean the oil cup and refill to the indicated level with clean engine oil. Use the same grade of oil in the cleaner as used in the crankcase. Make sure all the connections are tight so that the dust and the dirt cannot enter..

DONALDSON COMPANY

ELECTRICAL SYSTEM

Important

Any major overhauling or adjustment should be done by an International Service Station or authorized dealer.

How to Correct Minor Troubles

There are times when minor troubles are encountered on the road, and these are due generally to loose connections or defective terminals in the wiring system. These can be easily detected by observing the following:

1. If the engine runs but misses at times, look for:

Wiring - Battery terminals loose or corroded. High and low tension cables grounded or loosely connected.

Distributor - Contact points not set right.

Spark Plug - Gap should be between .028 to .032 inch. If misfiring is not confined to one cylinder, have the coil tested, wiring checked and the distributor inspected. If the engine misses regularly on one cylinder, the trouble is usually due to the spark plug in that cylinder being dirty, broken or improperly adjusted.

2. If the starting motor turns the engine, but no spark or a weak spark is obtained at the spark plug, look for:

Wiring - High and low tension cables may be grounded or loosely connected.

Distributor - Contact points either do not open or do not close. Gap should be between .018 to .024 inch.

Ignition Switch - Does not make contact.

Weak Battery - Low voltage will give a weak spark.

Starting Motor - Examine all cable connections between the battery and the starting motor. Connections must be clean and tight.

3. If the starting motor will not turn over, or turns slowly when the starting switch is closed, look for:

Battery - Weak or completely discharged.

Wiring - Loose or dirty battery connections. See that all cable connections between the battery and starting motor are clean and tight.

Starting Switch - Contact points burned or cable loose on terminal posts.

4. If the ammeter does not show that the generator is charging, look for:

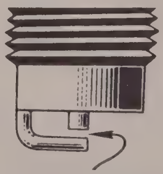
Generator - Commutator and brushes dirty or greasy. To clean, use No. 00 sandpaper. Never use emery cloth.

Wiring - Cable connections at the ammeter may be grounded or loosely connected. Also check the cable connections at the starting switch and the battery.

Regulator - If the trouble is within the regulator unit, it will not usually hinder an operator from reaching a service station for a check of the unit. Check the regulator to determine whether it is properly connected to a good ground.

Spark Plugs

We recommend that a periodic examination be made of the spark plugs to keep them free from carbon, also to see that the gap between the points is set .028 to .032 inch. When changing the gap, always bend the outer electrode, never bend the center electrode.



A-7375

Be accurate -- use a round-wire feeler gauge.

The proper method to clean fouled spark plugs is to use a reliable spark plug cleaner. See your International Service Station or authorized dealer for the best results.

Generator and Regulators

A shunt-wound belt-driven generator is provided; it is current-and-voltage controlled by regulators mounted on one base but operating independently to maintain the output and voltage within specified limits. Shunt-wound generator output can be changed only by adjustment of the regulators. If the regulator or generator wires are disconnected, or when changing the battery, observe the following instructions in order to avoid the possibility of reversing the polarity of the generator, thus vibrating and burning the cut-out relay contacts.

See that the positive side of the battery is grounded. The cable from the "F" terminal on the generator must be connected to the "F" terminal on the regulator. Cable from the "A" terminal on the generator must be connected to the "GEN" terminal on the regulator. Cable from the "BAT" terminal on the regulator must be connected to the ammeter. Then, before starting the engine, momentarily touch a lead (or screwdriver) from the "GEN" to the "BAT" terminals on the regulator. The surge of the battery current to the generator will correctly polarize the generator.

When replacing a battery, a quick check can be made to determine that the proper terminal (positive) is grounded before starting the engine, as follows:

After connecting the battery cables, turn on the headlights. If the ammeter shows "discharge", the battery is properly connected. If the ammeter indicates "charge", then the battery cables should be disconnected and reconnected so that the ammeter will show "discharge" when the lights are on.

Starting Motor

The starting motor is located at the left rear of the engine.

Caution: Do not run the starting motor more than approximately 30 seconds at any one time because it can be seriously damaged if held too long in contact. It is a good policy to remove the cover band on the starting motor and inspect the brushes and commutator at least once a year.

Storage Battery

Examine the battery at least twice a month during warm weather operation and once a month in cold weather to see that the solution is kept to the proper level. It is advisable to keep the battery fully charged at all times.

Caution: Hydrogen gas is produced in the normal operation of the battery in the vehicle. Therefore, it is imperative that flames or sparks be kept away from the vent openings of the battery. Failure to do so may result in destruction of the battery.

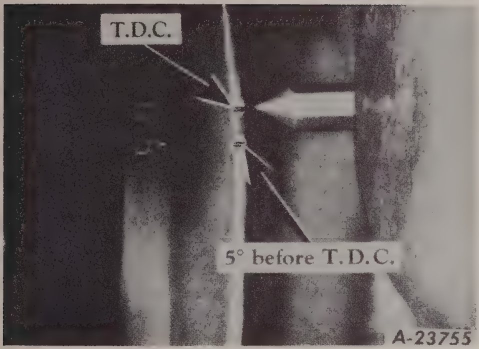
The electrolyte in each cell should be 3/8 inch above the separator plates, or to the indicated level. When the electrolyte is below this level, clean distilled water should be added, using a clean syringe. Acid or electrolyte should never be added except by a skilled battery man.

Under no circumstances add any special battery "dopes," solutions or powders.

Test the specific gravity of the electrolyte in each cell with a hydrometer at least once a month. A hydrometer reading of 1.270 to 1.285 indicates a full charge. Never allow the battery to fall below 1.255, which indicates half discharged. A discharged battery will freeze at 20° F. above zero. A fully charged battery will withstand temperatures as low as 45° F. to 90° F. below zero. See charts on following page.

Battery cable terminals must be clean and tight. Use hot water and common soda for removing terminal corrosion and for cleaning the top of the battery. Brighten the contact surface with steel wool, apply a light coat of vaseline, and reassemble. Be sure the terminals are clamped tightly and that the battery is clamped securely in the battery box.

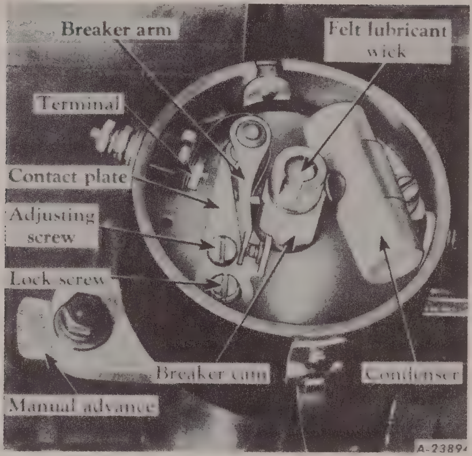
Ignition Timing


T.D.C.
5° before T.D.C.
A-23755

The ignition timing marks are on the crankshaft pulley and the timing pointer is on the timing gear cover. To assure efficient operation of the engine, the timing should be checked with a timing light, and the timing mark and pointer should be in the register position as indicated for the best engine performance. Two marks are located on the crankshaft pulley. Mark "O" indicates top dead center (T.D.C.) and the other mark "5" indicates 5° before top dead center (T.D.C.).

Note: When the oil pump has been removed from the engine, it will be necessary to remove the ignition distributor before reinstalling the pump assembly. This is required to assure proper alignment of the distributor shaft with the oil pump shaft. It will also be necessary to retime the ignition.

Distributor Contact Points


Breaker arm
Felt lubricant wick
Terminal
Contact plate
Adjusting screw
Lock screw
Breaker cam
Condenser
Manual advance
A-2389

The proper gap between the distributor breaker points is between .018 to .024 inch.

Cold Weather Operation

If the truck is to be operated in temperature of 32° F. or lower, observe the following precautions:

LUBRICATION

Engine oil must be changed to a winter grade, depending upon locality and type of service in which the truck is used. General recommendations will be found on *pages 42 and 43.*

Severe cold weather may make it advisable to change to a lighter grade lubricant in the transmission and in the rear axle differential. A lubricant of lighter viscosity will provide better lubrication to the moving parts. *See the lubrication chart, page 42.*

Important: The frequent use of the choke control button dilutes the crankcase oil by allowing unburned gasoline to leak down past the pistons, thus washing away lubricant from the pistons and cylinder walls and thinning the oil to a degree where its value as a protecting film between moving parts is destroyed. Because of this, we recommend a more frequent complete oil change in cold weather, refilling crankcase with new oil of good quality. *See page 43.*

COOLING SYSTEM

Before cold weather arrives, put a good antifreeze solution containing an effective rust corrosion preventive into the system.

Before adding solution, do the following:

1. Inspect all hoses. They should be in good condition inside and out. Install the hoses and tighten all hose clamps. Check for leaks.

2. Inspect the water pump for leaks.

3. Inspect the fan belt and adjust to the proper tension. If the belt is worn or oil-soaked, it is safer to install a new one.

4. The engine should be level so that all the water will drain out.

5. Remove the radiator filler cap and open the radiator drain cock; also remove the crankcase water drain plug (located on the right side of the crankcase toward the rear of the engine) and thoroughly drain the cooling system. Then close the drain cock and install the crankcase water drain plug. Flush the cooling system, using a recognized cleaning solution, following the manufacturer's instructions. If a commercial cleaning solution is not available, dissolve about four pounds of ordinary washing soda in sufficient water (28 quarts) to fill the system.

6. Leave the radiator filler cap off and run the engine for about one-half hour or until the engine gets hot. Then disconnect the radiator outlet hose to allow the larger particles of sediment to pass through, also removing the crankcase water drain plug. Drain and flush thoroughly with clean water. Close the drain cock, install the plug and securely fasten the radiator outlet hose.

7. Put the required amount of antifreeze into the cooling system. Add clean water and inspect the hose connections for leaks.

The use of a good winterfront, which will cover the lower portion of the radiator, is recommended in order to maintain an engine temperature between 160° and 180° F. During freezing weather, if antifreeze solutions are not used, the entire cooling system must be drained when the truck is not in use. Be sure to open the drain cock, and remove the crankcase water drain plug.

If a solution of alcohol and water is used, keep adding a small amount of alcohol from time to time to compensate for evaporation. Do not use calcium chloride or salt solutions.

Note: Do not use chemical mixtures to stop radiator leaks except in an emergency. Never use solutions instead of needed radiator repair.

Cold Weather Operation - Continued

PROPERTIES OF ANTIFREEZE SOLUTIONS

Denatured Alcohol

% By Volume	Freezing Point		Specific Gravity
	°C.	°F.	
0%	0	32	1.000
10%	-3	27	.988
20%	-7	19	.978
30%	-12	10	.968
40%	-19	-2	.957
50%	-28	-18	.943

Distilled Glycerine

% By Volume	Freezing Point		Specific Gravity
	°C.	°F.	
0%	0	32	1.000
10%	-2	29	1.029
20%	-6	21	1.057
30%	-11	12	1.085
40%	-18	0	1.112
50%	-26	-15	1.140

Methanol (Wood Alcohol)

% By Volume	Freezing Point		Specific Gravity
	°C.	°F.	
0%	0	32	1.000
10%	-5	23	.987
20%	-12	10	.975
30%	-19	-2	.963
40%	-29	-20	.952
50%	-40	-40	.937

Ethylene Glycol

% By Volume	Freezing Point		Specific Gravity
	°C.	°F.	
0%	0	32	1.000
10%	-3	26	1.016
20%	-9	16	1.031
30%	-16	3	1.045
40%	-24	-11	1.058
50%	-35	-31	1.070

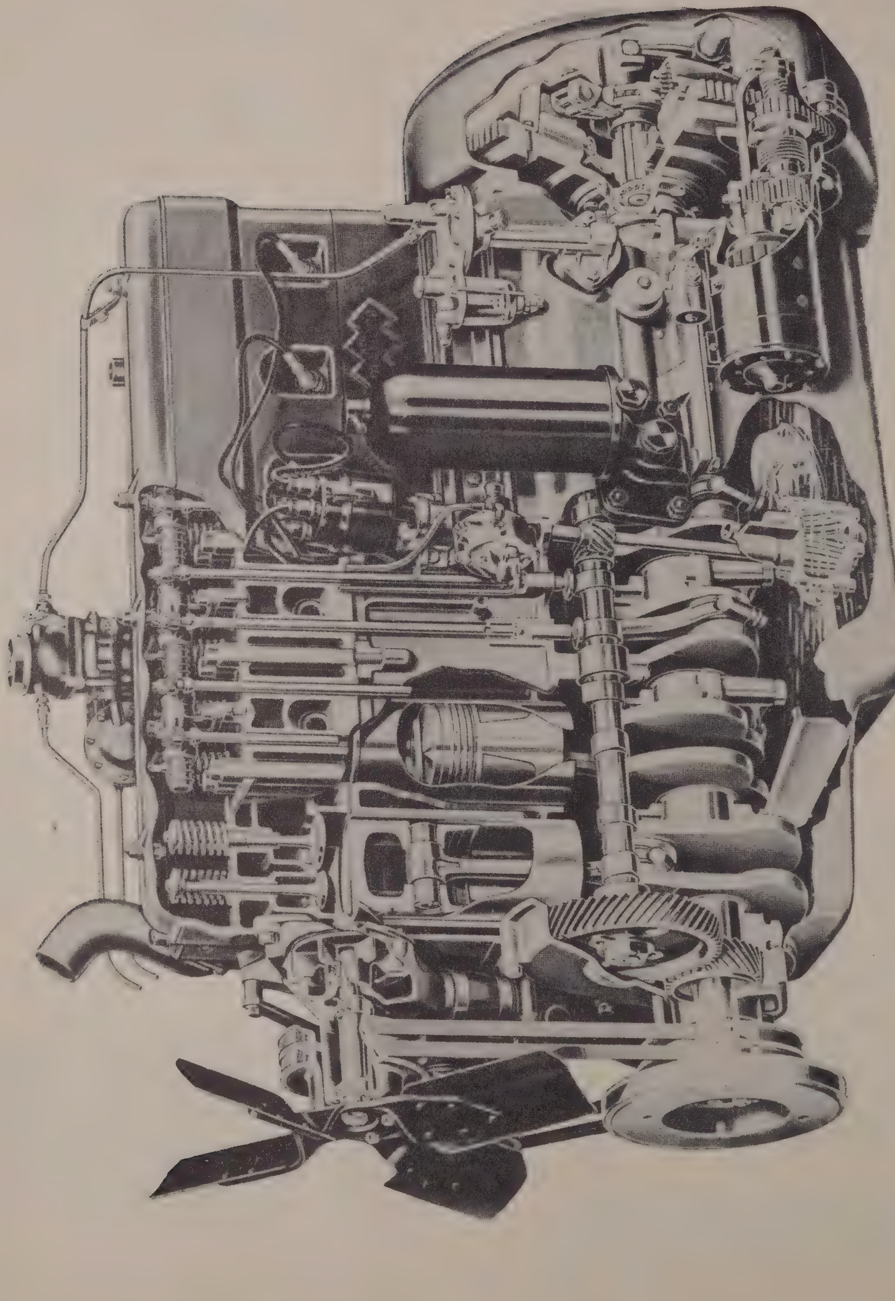
RUST PREVENTION

Rust and corrosion formation can be prevented by maintaining full strength corrosion protection at all times.

For rust protection during the winter months, a fresh filling of an antifreeze containing an effective corrosion preventive should be installed in the fall. In the spring, drain and discard the old antifreeze solution because the cooling liquid may have become contaminated by corrosive impurities during use and the rust preventives or "inhibitors" in the antifreeze solution may have become weakened and exhausted by continual driving.

During the summer, a rust preventive should be added to the cooling system to protect the system against corrosion during warm weather operation. This inhibitor solution should be drained in the fall and a fresh filling of chemically treated antifreeze solution again installed. *See page 17.*

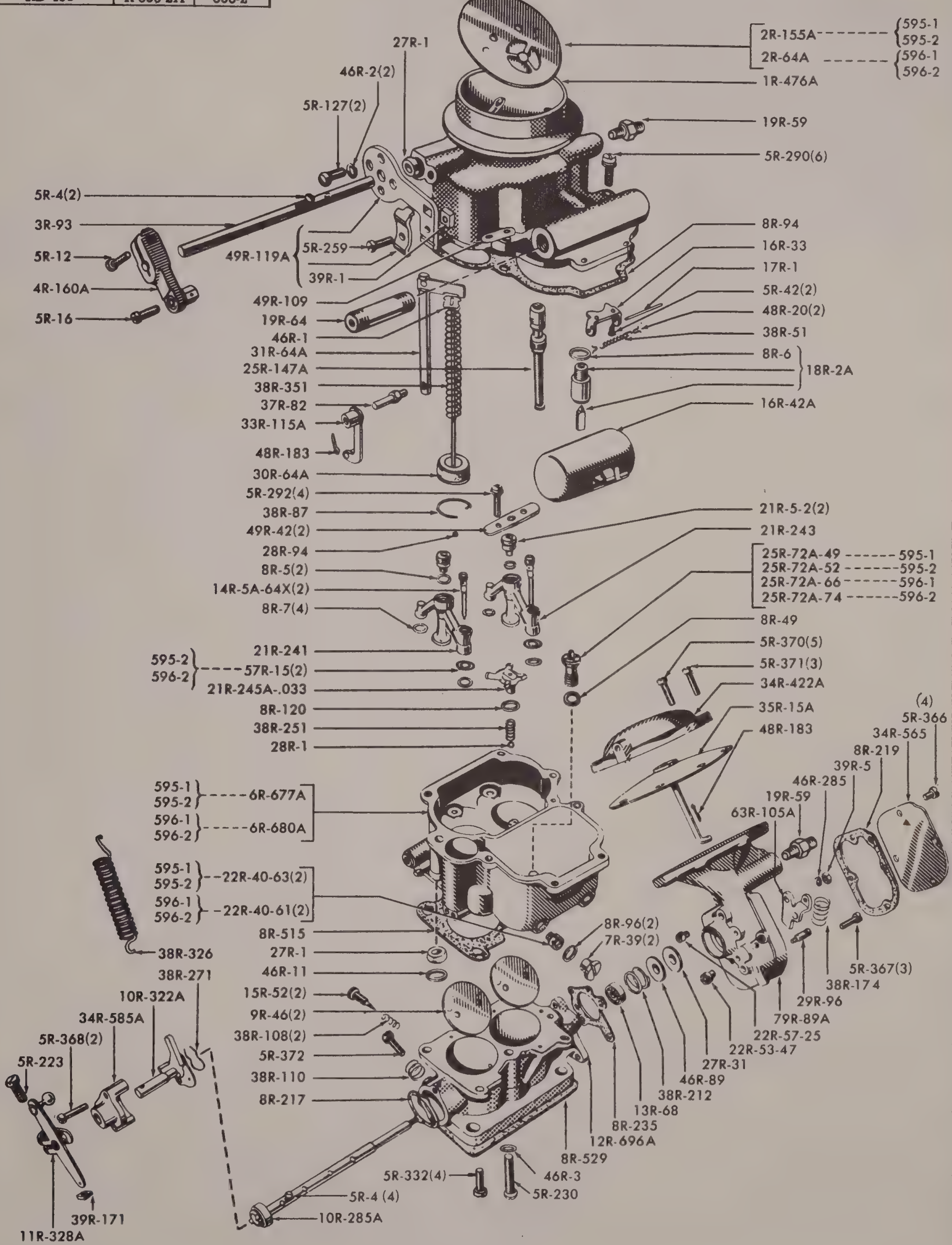
I. H. C. RED DIAMOND # 406 ENGINE



Sectional view.

I.H.C. 1950
TRUCK MODEL
L-200 to L-211

CARBURETOR MODEL 852-FFG		
ENGINE MODEL	PART NO.	LIST NO.
RD-406	R-595-1A	595-1
RD-406	R-595-2A	595-2


2R-155A ------- 595-1 595-2
2R-64A ------ 596-1 596-2
1R-476A
27R-1
46R-2(2)
5R-127(2)
19R-59
5R-290(6)
5R-4(2)
3R-93
5R-12
49R-119A
5R-259
39R-1
4R-160A
5R-16
8R-94
16R-33
17R-1
5R-42(2)
48R-20(2)
38R-51
8R-6
18R-2A
16R-42A
49R-109
19R-64
46R-1
31R-64A
25R-147A
38R-351
37R-82
33R-115A
48R-183
30R-64A
5R-292(4)
38R-87
49R-42(2)
28R-94
8R-5(2)
14R-5A-64X(2)
8R-7(4)
21R-5-2(2)
21R-243
25R-72A-49 ------ 595-1
25R-72A-52 ------ 595-2
25R-72A-66 ------ 596-1
25R-72A-74 ------ 596-2
8R-49
21R-241
595-2 596-2 ---- 57R-15(2)
21R-245A-.033
8R-120
38R-251
28R-1
5R-370(5)
5R-371(3)
34R-422A
35R-15A
48R-183
(4) 5R-366
34R-565
8R-219
39R-5
46R-285
19R-59
63R-105A
595-1 595-2 ---- 6R-677A
596-1 596-2 ---- 6R-680A
595-1 595-2 -- 22R-40-63(2)
596-1 596-2 - 22R-40-61(2)
8R-515
27R-1
46R-11
8R-96(2)
7R-39(2)
38R-326
38R-271
10R-322A
34R-585A
5R-368(2)
5R-223
15R-52(2)
9R-46(2)
38R-108(2)
5R-372
38R-110
8R-217
5R-367(3)
38R-174
29R-96
79R-89A
22R-57-25
22R-53-47
27R-31
46R-89
38R-212
13R-68
8R-235
12R-696A
8R-529
46R-3
5R-230
5R-332(4)
5R-4 (4)
10R-285A
39R-171
11R-328A

CARBURETOR

VENDOR: Holley Carburetor Company

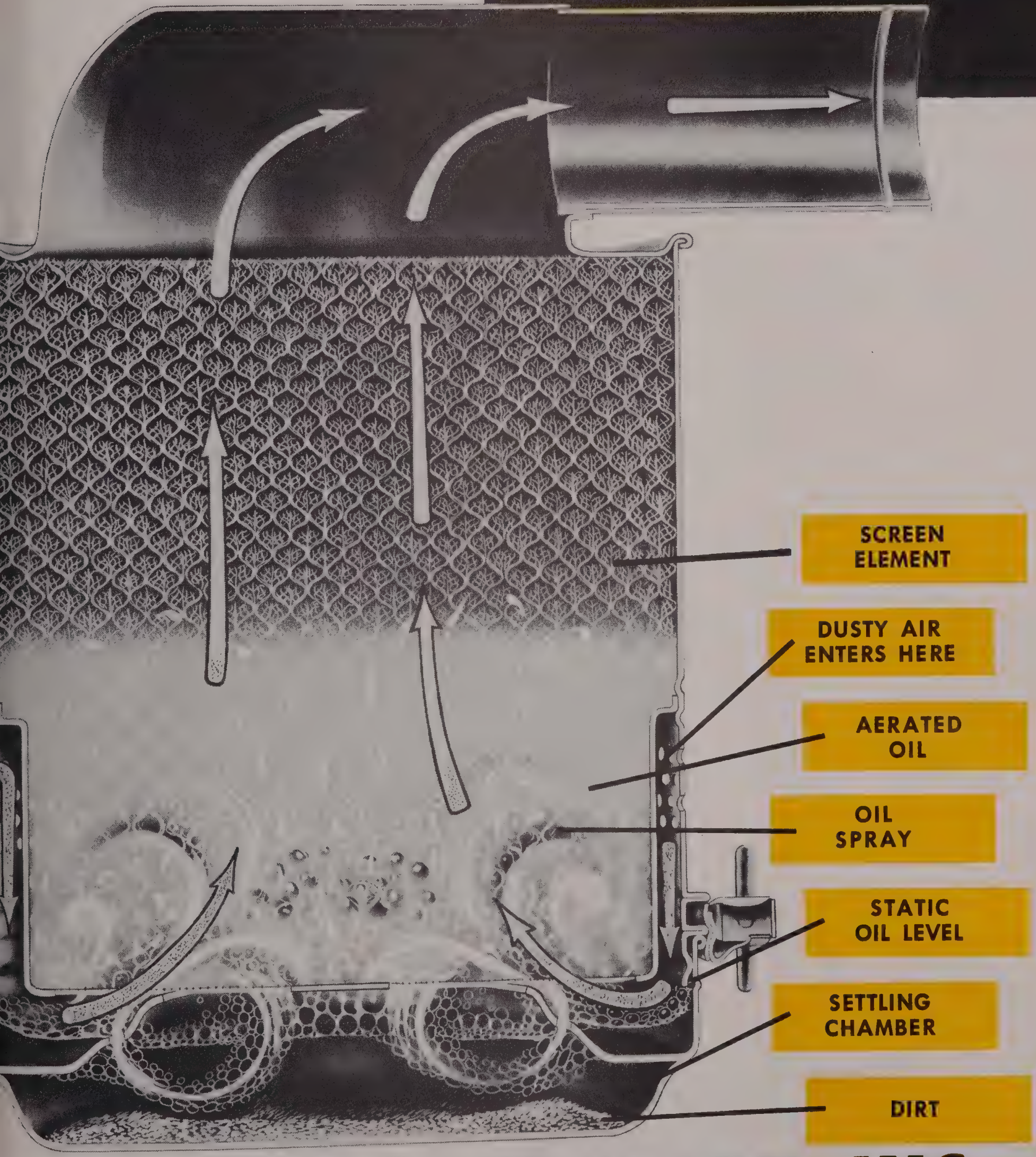
June 15, 1950

TRADE-MARK REG. U. S. PATENT OFFICE

Form No: H.C.-69E

DONALDSON "E" type *Oil Washed* AIR CLEANER

FUNCTIONAL DIAGRAM


SCREEN ELEMENT
DUSTY AIR ENTERS HERE
AERATED OIL
OIL SPRAY
STATIC OIL LEVEL
SETTLING CHAMBER
DIRT

DONALDSON COMPANY, INC.

666 Pelham Blvd., St. Paul 4, Minnesota

OPERATION AND CARE of the DONALDSON OIL-WASHED-AIR CLEANER

The air cleaner is put on the engine to prolong its life and performance by preventing dirt and grit from getting into the engine, causing excessive wear on all operating parts. *However, the operator is of necessity charged with the responsibility of giving the air cleaner equipment regular and constant attention in accordance with the instructions.*

Service air cleaner weekly—more frequently under severe dust conditions. Remove oil cup, empty oil, scrape out dirt. Fill to oil level bead with engine oil. Replace oil cup securely. *Never remove oil cup while engine is running.*

The oil cup should be kept filled as near as possible to the level indicated by the bead with *fresh oil. We recommend the following grades be used:*

S.A.E. 10 Oil—In freezing weather

S.A.E. 30 Oil—In warm weather

S.A.E. 40 Oil—In extremely hot weather

The best performance of the air cleaner is obtained by keeping the oil level up to the bead on the cup. Raising the oil level above this point *does not* increase the efficiency and this practice should be avoided.

It is absolutely necessary to change oil and thoroughly clean the cup whenever (or before) the level of dirt accumulated in the bottom of the cup reaches $1/2''$, or the oil appears too thick or heavy to spray or circulate properly. The depth of dirt at the bottom can be measured with a stick, screw driver, or whatever is convenient. *Weekly inspection* is necessary to enable the operator to see when any of these conditions have been reached.

Ordinarily, if the correct oil level is maintained with the proper grade of oil, the wire screen filtering element will need very little attention. However, the bottom of the screen element should be inspected whenever the cup is removed and any accumulation of heavy lint, chaff, leaves or straw removed.

All connections between the air cleaner and carburetor should be inspected at frequent intervals and must be kept tight. *See instructions on the air cleaner.*

DONALDSON COMPANY, INC.
666 Pelham Blvd., St. Paul 4, Minnesota

PRINTED IN U.S.A.

VENDOR: Hendrickson Motor Truck Company	DA-6063 WIRING DIAGRAM TEN TON CR. CAR.

ITEM	PART NO.	VENDOR	ITEM	PART NO.	VENDOR
1	614-Y	GUIDE	27	465489	ROSS
2	#67 Armor Clad Amber	KING BEE	28	1115045	DELCO-REMY
3	528 UXDT	KING BEE	29	4465	HALLETT
4	1997009	DELCO-REMY	30	2285	HALLETT
5	30 AMP		31	4536	HALLETT
6	4533	BUSSMAN	32	1016	HALLETT
7	1106835	DELCO-REMY	33	4432	HALLETT
8	4465	HALLETT	34	1112357	DELCO-REMY
9	1118376	DELCO-REMY	35	4035	HALLETT
10	4465	HALLETT	36	4536	HALLETT
11	440069	STW.-WARNER	37	XEJ-6	CHAMPION
12	1293	HALLETT	38	1010	HALLETT
13	1294	HALLETT	39	1011	HALLETT
14	1109006	DELCO-REMY	40	1012	HALLETT
15	1479	DELCO-REMY	41	1013	HALLETT
16	8806 Type 2H-23	WILLARD	42	1014	HALLETT
17	1385	DELCO-REMY	43	1015	HALLETT
18	441035	STW.-WARNER	44	2511	HALLETT
19	75911	KEYSTONE FAR.	45	4254	HALLETT
20	223578	BENDIX-WEST.	46	223220	BENDIX-WEST.
21	1116465	DELCO-REMY	47	468-06	GUIDE
22	7171	COLE-HERSEE	48	AE-1502	HENDRICKSON
23	72099	STW.-WARNER	49	AE-5345	HENDRICKSON
24	SW-24	AMER. MFG. DEV.	50	AE-1500	HENDRICKSON
25	WW-A-12-C114	AMER. BOSCH	51	AE-1501	HENDRICKSON
26	1908817	DELCO-REMY	52	82	POLLACK

SEE INSIDE

OPERATION AND CARE of the DONALDSON OIL-WASHED-AIR CLEANER

The air cleaner is put on the engine to prolong its life and performance by preventing dirt and grit from getting into the engine, causing excessive wear on all operating parts. *However, the operator is of necessity charged with the responsibility of giving the air cleaner equipment regular and constant attention in accordance with the instructions.*

Service air cleaner weekly—more frequently under severe dust conditions. Remove oil cup, empty oil, scrape out dirt. Fill to oil level bead with engine oil. Replace oil cup securely. *Never remove oil cup while engine is running.*

The oil cup should be kept filled as near as possible to the level indicated by the bead with *fresh oil. We recommend the following grades be used:*

S.A.E. 10 Oil—In freezing weather

S.A.E. 30 Oil—In warm weather

S.A.E. 40 Oil—In extremely hot weather

The best performance of the air cleaner is obtained by keeping the oil level up to the bead on the cup. Raising the oil level above this point *does not* increase the efficiency and this practice should be avoided.

It is absolutely necessary to change oil and thoroughly clean the cup whenever (or before) the level of dirt accumulated in the bottom of the cup reaches $1/2''$, or the oil appears too thick or heavy to spray or circulate properly. The depth of dirt at the bottom can be measured with a stick, screw driver, or whatever is convenient. *Weekly inspection* is necessary to enable the operator to see when any of these conditions have been reached.

Ordinarily, if the correct oil level is maintained with the proper grade of oil, the wire screen filtering element will need very little attention. However, the bottom of the screen element should be inspected whenever the cup is removed and any accumulation of heavy lint, chaff, leaves or straw removed.

All connections between the air cleaner and carburetor should be inspected at frequent intervals and must be kept tight. *See instructions on the air cleaner.*

DONALDSON COMPANY, INC.
666 Pelham Blvd., St. Paul 4, Minnesota

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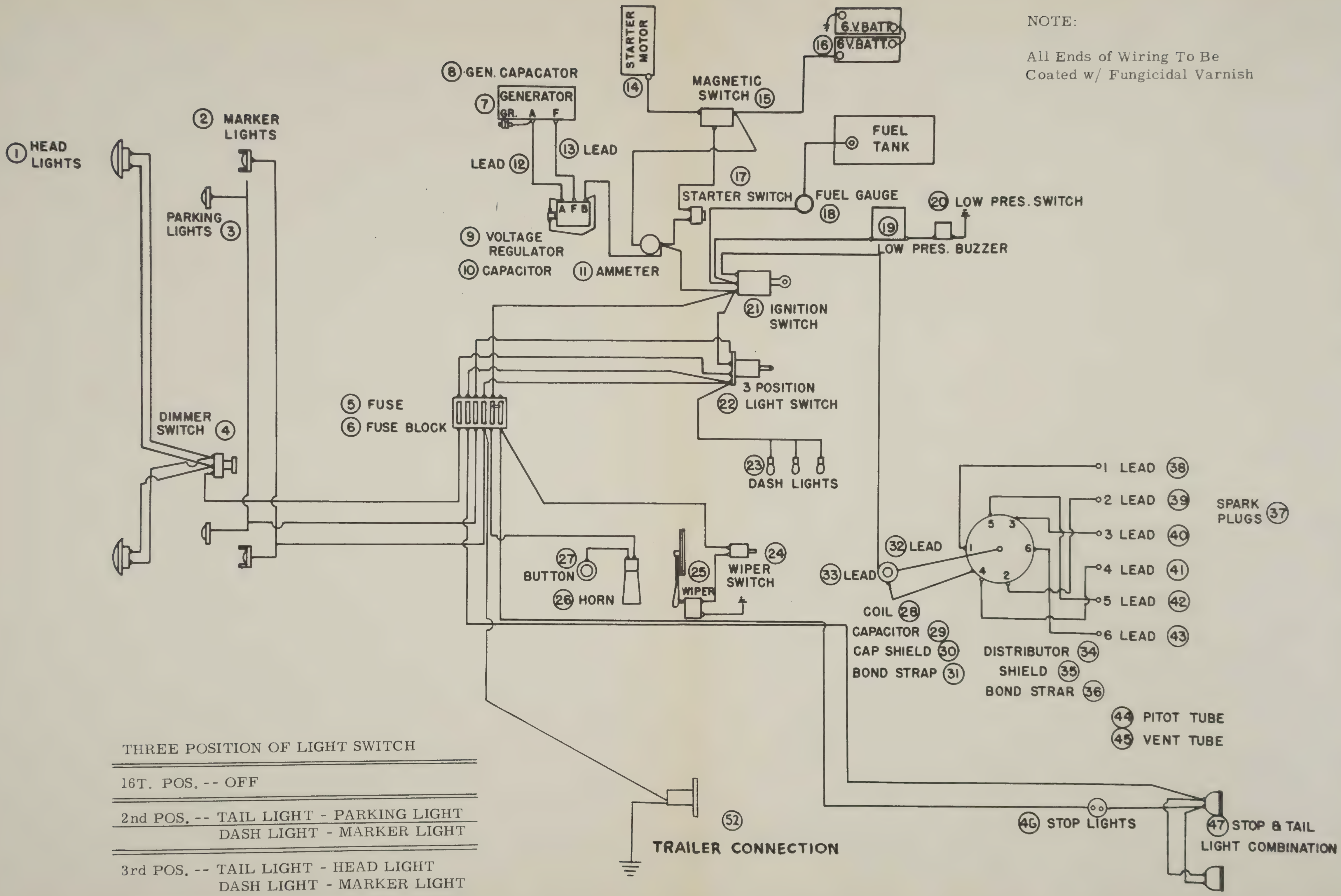
NOTE:

All Ends of Wiring To Be
Coated w/ Fungicidal Varnish


①HEAD LIGHTS
② MARKER LIGHTS
PARKING LIGHTS ③
DIMMER SWITCH ④
⑤ FUSE
⑥ FUSE BLOCK
⑦ GENERATOR
GR. A F
⑧ GEN. CAPACATOR
⑨ VOLTAGE REGULATOR
A F B
⑩ CAPACITOR
⑪ AMMETER
LEAD ⑫
⑬ LEAD
STARTER MOTOR
⑭
MAGNETIC SWITCH ⑮
⑯ 6.V.BATT.
6.V.BATT.
⑰ STARTER SWITCH
FUEL GAUGE ⑱
FUEL TANK
⑲ LOW PRES. BUZZER
⑳ LOW PRES. SWITCH
㉑ IGNITION SWITCH
3 POSITION
㉒ LIGHT SWITCH
㉓ DASH LIGHTS
㉔ WIPER SWITCH
㉕ WIPER
㉖ HORN
㉗ BUTTON
COIL ㉘
CAPACITOR ㉙
CAP SHIELD ㉚
BOND STRAP ㉛
㉜ LEAD
㉝ LEAD
DISTRIBUTOR ㉞
SHIELD ㉟
BOND STRAR ㊱
5 3 1 6 4 2
SPARK PLUGS ㊲
1 LEAD ㊳
2 LEAD ㊴
3 LEAD ㊵
4 LEAD ㊶
5 LEAD ㊷
6 LEAD ㊸
㊹ PITOT TUBE
㊺ VENT TUBE
㊻ STOP LIGHTS
㊼ STOP & TAIL LIGHT COMBINATION
(52)
TRAILER CONNECTION

THREE POSITION OF LIGHT SWITCH

16T. POS. -- OFF

2nd POS. -- TAIL LIGHT - PARKING LIGHT
DASH LIGHT - MARKER LIGHT

3rd POS. -- TAIL LIGHT - HEAD LIGHT
DASH LIGHT - MARKER LIGHT

DELCO-REMY
SERVICE BULLETIN

BULLETIN 1S-120
Date 2-23-49
4 Pages Page 1
File Under:
S-MAGNETIC AND SOLENOID SWITCHES

Supersedes Bulletin
1S-120 Dated 11-4-46

OPERATION AND MAINTENANCE OF
MAGNETIC AND SOLENOID SWITCHES

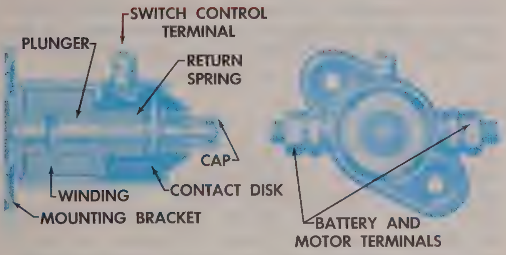

SWITCH CONTROL TERMINAL
PLUNGER
RETURN SPRING
CAP
WINDING
CONTACT DISK
MOUNTING BRACKET
BATTERY AND MOTOR TERMINALS

Figure 1—End and sectional views of magnetic switch. Some switches of this type have a push rod cap as shown while others do not.

Magnetic and solenoid switches are designed to electromagnetically perform mechanical jobs such as closing an electric circuit or shifting the cranking motor drive pinion into mesh with the engine flywheel ring-gear for cranking. Such switches consist of a winding or windings energized by external means from the battery. This causes a movable core or plunger to be pulled into the winding to produce the above-mentioned action. Delco-Remy manufactures several types of magnetic switch and solenoid switch. One of these, the solenoid-operated series-parallel switch is discussed in Bulletin 1S-130. Other types operate and are serviced as follows:

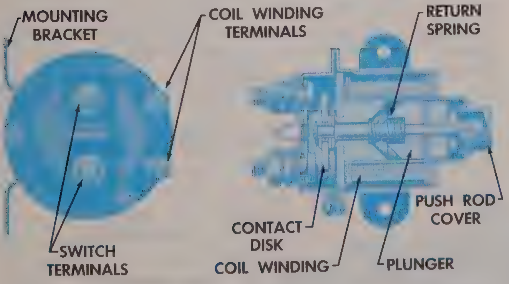

MOUNTING BRACKET
COIL WINDING TERMINALS
RETURN SPRING
SWITCH TERMINALS
CONTACT DISK
COIL WINDING
PLUNGER
PUSH ROD COVER

Figure 2—End and sectional views of magnetic switch of the type which can be disassembled.

MAGNETIC SWITCHES

Figures 1 to 3 illustrate three typical Delco-Remy magnetic switches. The switch shown in Figure 1 is not subject to any disassembly. Some magnetic switches of this type have a push rod cap as shown which can be removed so that the contact disk can be forced in against the switch contacts manually for starting. Others do not have this cap.

Figure 2 illustrates a magnetic switch which can be disassembled by unscrewing the three screws attaching the terminal plate assembly to the switch case. This permits removal of the contact disk and shaft assembly, plunger stop, plunger and winding from the case.

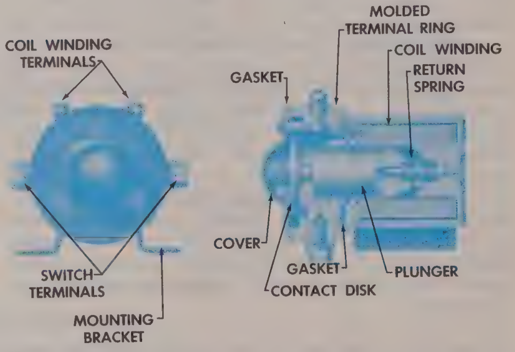

COIL WINDING TERMINALS
MOLDED TERMINAL RING
GASKET
COIL WINDING
RETURN SPRING
COVER
GASKET
PLUNGER
CONTACT DISK
SWITCH TERMINALS
MOUNTING BRACKET

Figure 3—End and sectional views of sealed-type magnetic switch which uses gaskets to seal the contact compartment.

Figure 3 illustrates a switch of somewhat similar construction to that shown in Figure 2 except that the terminals are assembled into a molded terminal ring which is held in place on the switch case by the cover and cover attaching screws. Gaskets on both sides of the ring seal the contact compartment as a protection against moisture or dirt. The winding assembly is not removable from the case on this unit although the contact disk, plunger and plunger return spring can be removed by removal of the cover.

MAGNETIC SWITCH TESTS

(See Bulletin 1S-180 for Specifications)

Connect a test voltmeter between the switch control terminals and connect a source of variable voltage to these terminals. Where the magnetic switch has but one control terminal, make these connections between that terminal and the switch base. A battery and a variable resistance connected in series will be found to be a suitable source of variable voltage. Increase the voltage on the switch slowly and note the voltage required to close the contacts. Closing of the contacts is indicated by a click which can normally be heard. A more accurate way of checking the instant that the contacts close is to connect test lamp points between the two main switch terminals. The lamp will light as the contacts close.

With an ammeter connected in series with the magnetic switch winding, increase the voltage to the specified value and note the current draw.

SOLENOID SWITCHES

The solenoid switch on a cranking motor not only closes the circuit between the battery and the cranking motor but also shifts the cranking motor pinion into mesh with the engine flywheel ring-gear. This is accomplished by means of a linkage between the solenoid switch plunger and the shift lever on the cranking motor. Figure 4 illustrates a sectional and end view of a solenoid switch with a solenoid relay. Bulletin 1M-100 illustrates a typical cranking motor control circuit using this type of solenoid and relay. Other types of cranking motors using solenoid switches are illustrated in Bulletins 1M-120, 1M-130 and 1M-150. A new type motor described in Bulletin 1M-150 is equipped with a solenoid without a relay. These solenoids are energized directly from the battery through the push button switch. The plunger stud linkage in these solenoids is not adjustable, and the plunger is considered a part of the motor assembly. Basic operation of both types of solenoids, however, is the same.

Figure 5 is a wiring circuit of the solenoid and relay shown in Figure 4. (The wiring circuit of solenoids without a relay is identical except that the junction of the winding leads is connected directly to a small switch terminal, and the relay is eliminated.) When the circuit between the battery and the relay winding (shown in blue) is closed by functioning of the external control circuit, the relay contacts close to connect the solenoid windings to the battery. (Without a relay, this is accomplished simply by closing the push button switch.) There are two windings in the solenoid: a pull-in winding (shown in dashed red) and a hold-in winding (shown in dotted red). Both windings, when energized in this manner, produce a magnetic field which pulls in the plunger so that the drive pinion is shifted into mesh, and the main contacts in the solenoid switch are closed to connect the battery directly to the cranking motor. Closing of the main switch contacts shorts out the pull-in winding (shown in dashed red) since this winding is connected across the main contacts. The magnetism produced by the hold-in winding is sufficient to hold the plunger in, and shorting out the pull-in winding reduces drain on the battery. When the control circuit between the relay winding and the battery is opened, the relay opens its points, disconnecting the hold-in winding from the battery. (This is accomplished by opening the push button switch on installations without a relay.) When the hold-in winding is disconnected from the battery the shift lever spring withdraws the plunger from the solenoid, opening the solenoid switch contacts and at the same time withdrawing the drive pinion from mesh. Proper operation of the switch depends on maintaining a definite balance between the magnetic strengths of the pull-in and hold-in windings.

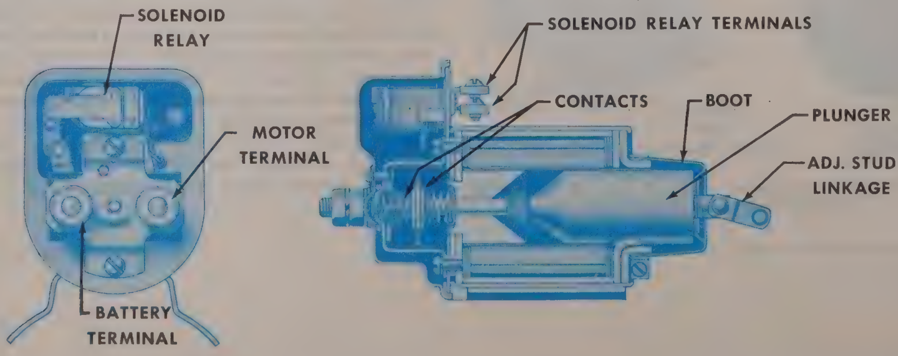


Figure 4—End and sectional views of solenoid switch and relay of the type used on cranking motors.

This balance is established in the design by the size of wire and the number of turns specified. An open circuit in the hold-in winding or attempts to crank with a discharged battery will cause the switch to chatter.

The solenoid equipped with a relay is disassembled by removing the cover, unscrewing the two screws that hold the terminal bracket assembly to the switch case, and then removing the contact disk assembly and relay assembly. Leads must be unsoldered before the relay assembly can be removed. Figure 6 is an exploded view of the unit.

To disassemble the solenoid without a relay, unscrew cover attaching screw and remove cover. Remove terminal bracket assembly screws, unsolder solenoid winding leads, and withdraw terminal assembly, push rod, and contact disk assembly.

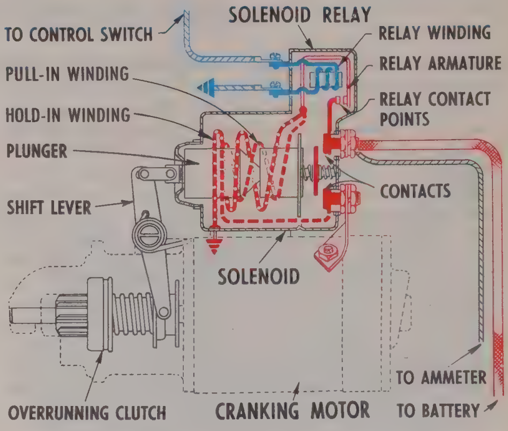

TO CONTROL SWITCH
SOLENOID RELAY
RELAY WINDING
RELAY ARMATURE
PULL-IN WINDING
HOLD-IN WINDING
RELAY CONTACT POINTS
PLUNGER
CONTACTS
SHIFT LEVER
SOLENOID
TO AMMETER
OVERRUNNING CLUTCH
CRANKING MOTOR
TO BATTERY

Figure 5—Wiring circuit of relay and solenoid shown in Figure 4.

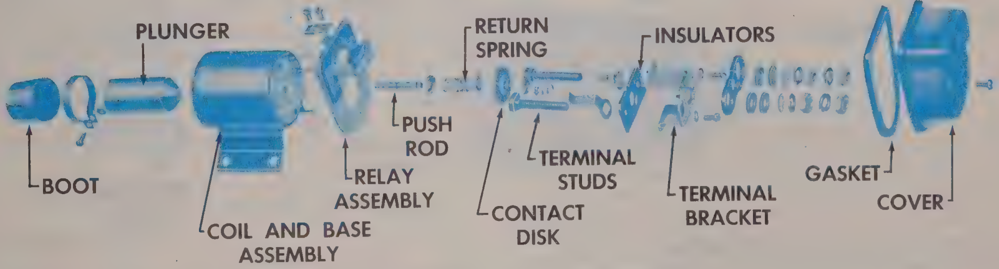

PLUNGER
RETURN SPRING
INSULATORS
PUSH ROD
BOOT
RELAY ASSEMBLY
TERMINAL STUDS
GASKET
TERMINAL BRACKET
COVER
CONTACT DISK
COIL AND BASE ASSEMBLY

Figure 6—Exploded view of solenoid shown in Figure 4.

SOLENOID SWITCH TESTS

(See Bulletin 1S-180 for Test Specifications)

Two tests must be made to determine the current draw of (1) both windings in parallel and (2) the hold-in winding alone. The solenoid windings can be tested with the solenoid either off or on the cranking motor. However, when the solenoid is checked on the cranking motor, it is necessary to disconnect both leads at the main solenoid terminals to prevent interference. The main solenoid terminal which is normally connected to the cranking motor must then be grounded to the solenoid base by means of a jumper lead. For the first test, remove the relay cover and connect a source of variable voltage (battery and a variable resistance) in series with an ammeter between the solenoid base and the solenoid winding leads where they are soldered to the solenoid relay (Fig. 5). (On solenoids without a relay, connect from solenoid base to small switch terminal.) Connect a voltmeter between the same two points (that is between the solenoid base and the junction of the winding leads). Slowly increase voltage and note the current draw at the voltage specified in the solenoid test specifications. Disconnect the jumper lead grounding the main solenoid terminal and readjust the variable resistance to obtain the specified voltage to check current draw of the hold-in winding.

CAUTION: Do not close the solenoid relay contact points while making this test since this would cause a direct short when the solenoid switch operated.

The solenoid relay should be checked as outlined in Bulletin 1R-100.

When the solenoid has been removed from the cranking motor for repair or replacement, the linkage must be adjusted to provide the correct pinion clearance or pinion travel when the solenoid is remounted on the cranking motor. Solenoids equipped with relays have an adjustable plunger stud, but solenoids without relays must be moved on the motor frame to adjust pinion travel (see Bulletin 1M-150).

SOLENOID ON DYER DRIVE CRANKING MOTOR

Bulletin 1M-130 illustrates a solenoid on a Dyer drive cranking motor. Figure 7 is an exploded view of this type of solenoid switch. Disassembly of the switch is made by removing the screws or nuts attaching the terminal plate assembly. The contact disk can be detached from the plunger and rod assembly by removing the cotter pin and unscrewing the castellated nut. The contact disk may sometimes require removal so that its face can be wire-brushed to remove corrosion. On reassembly, the castellated nut should be tightened down so that the face of the disk is 1 1/32 inch below the edge of the housing with the plunger in the retracted position. After assembly is completed, fill the bushing in the terminal plate assembly through which the lead passes (where present) with sealing material to prevent entrance of dust.

The two solenoid windings can be tested separately. Test the pull-in winding by connecting between the solenoid switch terminal and the solenoid motor terminal with a source of variable voltage (battery and variable resistance in series) and an ammeter. Connect voltmeter between the same terminals. Adjust variable resistance to secure specified voltage and note current draw. Test hold-in coil in similar manner except make connections between solenoid switch terminal and the other small solenoid terminal. After reassembly on cranking motor, adjust stud in the solenoid plunger (see Bulletin 1M-150) to secure proper travel of the Dyer pinion.

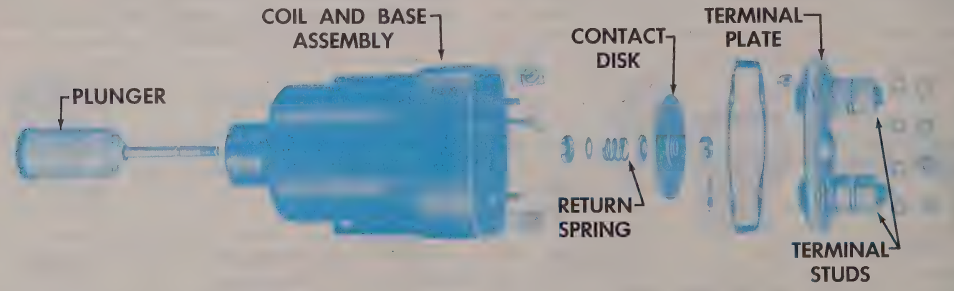


Figure 7—Exploded view of heavy-duty type solenoid used with Dyer drive cranking motors.

OTHER SOLENOIDS

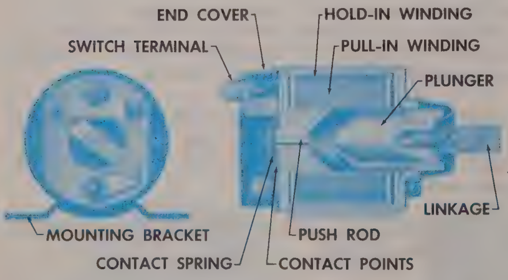


Figure 8—End and sectional views of solenoid switch.

The solenoid shown in Figure 8 is representative of other types of solenoid used to perform mechanical jobs electromagnetically. This solenoid has two windings, a pull-in winding and a hold-in winding. As the plunger bottoms, it actuates the push rod which opens contacts and thus opens the pull-in winding circuit. Thus, only the hold-in winding circuit remains closed to provide the magnetism needed to retain the plunger in the bottomed position.

DELCO-REMY
SERVICE BULLETIN

BULLETIN **1G-150**
Date 9-12-50
12 Pages Page 1
File Under:
G-GENERATORS

Supersedes Bulletin
1G-150, Dated 2-4-49

ADJUSTMENTS, TESTS AND MAINTENANCE OF
GENERATORS

The best assurance of obtaining maximum service from generators with minimum trouble is to follow a regular inspection and maintenance procedure. Periodic lubrication where required, inspection of the brushes and commutator, and checking of the brush spring tension are essentials in the inspection procedure. In addition, disassembly and thorough overhauling of the generator at periodic intervals is desirable as a safeguard against road failures from accumulations of dust and grease and normal wear of parts. This is particularly desirable on commercial vehicles where maintenance of operating schedules is of especial importance. In addition to the generator itself, the external circuits between the generator, regulator and battery must be kept in good condition since defective wiring, loose or corroded connections will prevent normal generator and regulator action. Regulator servicing procedures are contained in the applicable regulator service bulletins.

GENERATOR MAINTENANCE

LUBRICATION

Bearings provided with hinge cap oilers or oil reservoirs should have 8 to 10 drops of medium engine oil at vehicle lubrication periods. Generators with grease cups and ball bearings should have the grease cups turned down one full turn every 5,000 miles. The grease cups should be kept filled with Delco-Remy Cam and Ball Bearing Lubricant. In units which have relief holes in the grease passage, the holes must be prevented from clogging since this would force lubricant out onto the commutator. Generators with high pressure grease fittings should be lubricated with Delco-Remy Cam and Ball Bearing Lubricant every 5,000 miles.

On tractor, marine, or stationary applications, lubricate every 100 hours of operation.

Avoid excessive lubrication since this might cause lubricant to be forced out onto the commutator where it would gum and cause poor commutation. Such a condition results in reduced generator output and increased commutator and brush wear.

Never lubricate the commutator and do not lubricate the generator while it is in operation. Be sure to keep all lubricants clean and in closed containers.

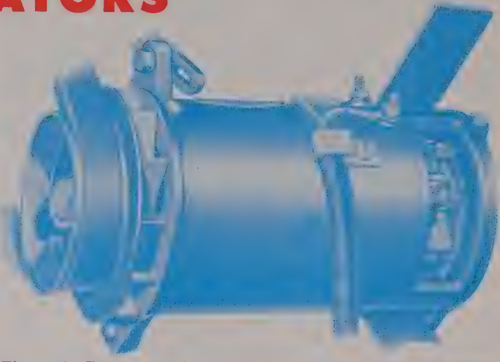


Figure 1—Generator with cover band removed for inspection of brushes and commutator.

INSPECTION

At periodic intervals, the generator should be inspected to determine its condition. The frequency with which this should be done will be determined by the type and design of generator as well as the type of service in which it is used. High speed operation, excessive dust or dirt, high temperatures and operating the generator at or near full output most of the time are all factors which increase bearing, commutator and brush wear. Generally speaking, the smaller units should be inspected at approximately 5,000 mile intervals while the larger unit may not require as frequent inspection. The inspection procedure follows.

First, inspect the terminals, external connections and wiring, mounting, pulley and belt. Then, remove the cover band (Fig. 1) so that the commutator, brushes and internal connections can be inspected. If the commutator is dirty, it may be cleaned with a strip of No. 00 sandpaper. Never use emery cloth to clean the commutator.

The sandpaper may be used by holding it against the commutator with a wood stick while the generator is in operation, moving it back and forth across the commutator. Gum and dirt will be sanded off in a few seconds. All dust should be blown from the generator after the commutator has been cleaned. A brush seating stone (Fig. 2) can also be used to clean the commutator.

If the commutator is rough, out of round, or has high mica, the generator must be removed and disassembled so that the armature can be turned down in a lathe and the mica undercut (page 11).

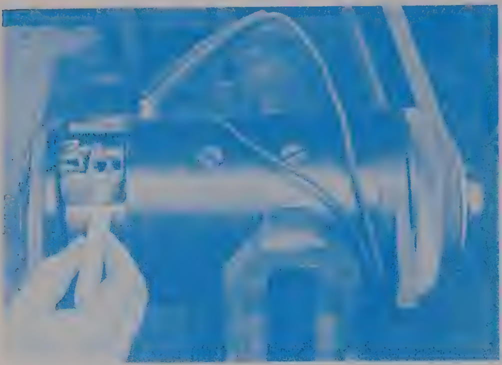


Figure 2—Using brush seating stone to seat new brushes or to clean off commutator.

If the brushes are worn down to less than half their original length, they should be replaced. Compare the old brush with a new one to determine how much it is worn. New brushes should be seated to make sure that they are in good contact with the commutator. A convenient tool for seating brushes is a brush seating or bedding stone. This is a soft abrasive material which, when held against a revolving commutator, disintegrates so that particles are carried under the brushes and wear their contacting faces to the contour of the commutator in a few seconds. Figure 2 illustrates the manner in which a brush seating stone is used. After replacing brushes on a third-brush generator, the generator output should be checked (see right) since this sometimes causes a change in the third-brush position which, in turn, produces a change of generator output. All dust should be blown from the generator after the brushes are seated.

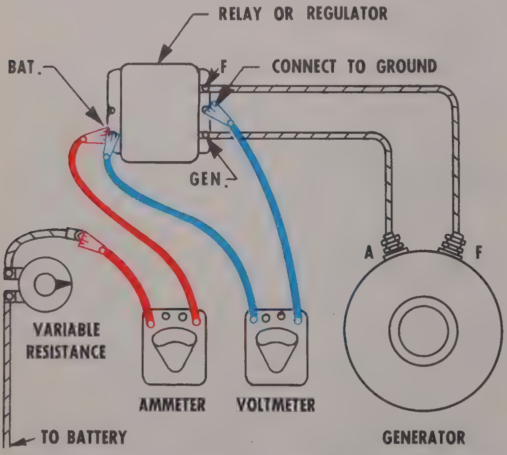


Figure 3—Meter connections to check third-brush generator output. Ammeter leads shown in red while voltmeter leads are shown in blue.

The brush spring tension must be correct since excessive tension will cause rapid brush and commutator wear, while low tension causes arcing and burning of the brushes and commutator. Brush spring tension can be checked with a spring gauge hooked on the brush arm or brush attaching screw. Correction can be made by bending the brush spring as required. If the brush spring shows evidence of overheating (blued or burned) do not attempt to readjust it but install a new spring. Overheating will cause a spring to lose its temper.

If the generator is belt-driven, the belt should be checked to make sure that it is in good condition and has correct tension. Low belt tension will permit belt slippage with a resulting rapid belt wear and low or erratic generator output. Excessive belt tension will cause rapid belt and bearing wear. The belt tension should be adjusted in accordance with specifications of the engine or vehicle manufacturer.

THIRD-BRUSH GENERATOR OUTPUT CHECK

(See Test Specification Bulletins 1G-180 and 1G-185)

Third-brush generator output can be checked by connecting an ammeter and variable resistance in series into the charging circuit at the relay or regulator "BAT" or BATTERY terminal and connecting a voltmeter between this terminal and ground as shown in Figure 3. Terminal locations will vary with different models and are not all in the location shown in Figure 3. Make meter connections according to terminal markings and not relative locations indicated in illustration. If the generator has a regulator or control, the "F" terminal must be grounded temporarily with a jumper lead to prevent any regulator action which would reduce generator output. (On generators using heavy-duty regulators of the type discussed in Bulletin 1R-122, connect "F" terminal to the "A" terminal instead of grounding it.)

With the generator at operating temperature, increase generator speed to the specified value, adjust the variable resistance to obtain the specified voltage and note generator output. Generator output must be checked with the generator at operating temperature and operating at the specified speed and voltage. If the generator is checked with a fully charged battery in the circuit, the variable resistance may not be required, but if the battery is not fully charged, it will be needed in order to increase the voltage to the specified value.

NOTE: When checking a generator with a manually or thermostatically controlled field resistance, make sure that the field resistance is shorted out of the field circuit before attempting to check and adjust generator output.

On many third-brush generator models, it will be found that the third brush is fixed and cannot be adjusted. This type unit is used with a voltage regulator which provides necessary control of generator output under various operating conditions. Where the third brush is adjustable, generator output may be increased by moving the third brush in the direction of armature rotation and decreased by moving the third brush in the opposite direction. The third brush is mounted on a movable ring in the commutator end frame. This ring is normally held in place by one or more clamping screws which must be loosened before the third-brush ring can be shifted. Some models have the screw accessible on the outside while others have the clamping screw inside the commutator end frame so that the cover band must be removed to reach it. Be sure to tighten the screw down well after the adjustment is completed.

On some applications where the electrical requirements are small, it may be found that maximum generator output is sufficient to produce battery overcharge. Under this condition, the generator output should be reduced below the specified maximum by adjusting the third brush so that it will just meet operating requirements without causing battery overcharge.

Never adjust the generator output above the specified maximum and never operate the generator on open circuit.

SHUNT GENERATOR OUTPUT

The maximum output of shunt generators is determined by the current setting of the current regulator with which the shunt generator is used Checking of this setting is discussed in the applicable regulator bulletin.

CHECKING DEFECTIVE GENERATORS

If the generator-regulator system does not perform according to specifications (generator does not produce rated output or produces excessive output), and the trouble has been isolated in the generator itself by following the "QUICK-CHECK" procedure outlined in the applicable regulator bulletin, the generator may be checked further as follows to determine the location of trouble in the generator.

NO OUTPUT

If the generator will not produce any output, remove the cover band and check the commutator, brushes and internal connections. Sticking brushes, a dirty or gummy commutator (see Armature Service, page 11), or poor connections may prevent the generator from producing any output. Thrown solder on the cover band indicates that the generator has been overloaded (allowed to produce excessive output) so it has overheated and melted the solder at the commutator riser bars. The solder has been thrown out: often, this leads to an open circuit and burned commutator bars (see paragraph 4, following). If the brushes are satisfactorily seated and are making good contact with the commutator, and the cause of trouble is not apparent, use a set of test points and a test lamp as follows to locate the trouble (leads must be disconnected from generator terminals).

1. Raise the grounded brush (or brushes) from the commutator and insulate with a piece of cardboard. Check for grounds with test points from the generator main brush or "A" terminal to the generator frame. If the generator is of the type in which the field is internally grounded to the field frame*, disconnect the field ground lead before making this test. If the lamp lights, it indicates that the generator is internally grounded. Location of the ground can be found by raising and insulating all brushes from the commutator and checking the brush holders, armature or commutator, and field separately. Repair or replace parts as required (see Inspection and Repair section, page 11).

*If a grounded field is found in a generator of this type, check the regulator contact points since a grounded field may have permitted an excessive field current which will have burned the regulator contact points. Burned regulator points should be cleaned or replaced as required.

2. If the generator is not grounded, check the field for an open circuit with a test lamp. The lamp should light when one test point is placed on the field terminal or grounded field lead and the other is placed on the brush holder to which the field is connected. If it does not light the circuit is open. If the open is due to a broken lead or bad connection, it can be repaired but if the open is inside one of the field coils, the coil must be replaced.

3. If the field is not open, check for a short circuit in the field by connecting a battery of the specified voltage and an ammeter in series with the field circuit. Proceed with care since a shorted field may draw excessive current which might damage the ammeter. If the field is not within specification, new field coils will be required. (See Bulletins 1 G-180 and 1 G-185 for specifications.)

   NOTE: If a shorted field is found, check the regulator contact points since a shorted field may have permitted excessive field current which would have caused the regulator contact points to burn. Clean or replace points as required.

4. If the trouble has not yet been located, check the armature for open and short circuits. Open circuits in the armature are usually obvious since the open circuited commutator bars will arc every time they pass under the generator brushes so that they will soon become burned. If the bars are not too badly burned and the open circuit can be repaired, the armature can usually be saved (see page 11). In addition to

repairing the armature, generator output must be brought down to specifications to prevent overloading by readjustment of the regulator or third brush.

Short circuits in the armature are located by use of a growler. The armature is placed in the growler and slowly rotated (while a thin strip of steel such as a hacksaw blade is held above the armature core). The steel strip will vibrate above the area of the armature core in which short circuited armature coils are located. If the short circuit is obvious, it can often be repaired so that the armature can be saved (see page 11).

UNSTEADY OR LOW OUTPUT

If the generator produces a low or unsteady output, the following factors should be considered:

1. A loose drive belt will slip and cause a low or unsteady output.
2. Brushes which stick in their holders, or low brush spring tension will prevent good contact between the brushes and commutator so that output will be low and unsteady. This will also cause arcing and burning of the brushes and commutator.
3. If the commutator is dirty, out of round, or has high mica, generator output is apt to be low and unsteady. The remedy here is to turn the commutator down in a lathe and undercut the mica (see page 11). Burned commutator bars may indicate an open circuit condition in the armature as already stated above (paragraph 4, under NO OUTPUT).

EXCESSIVE OUTPUT

When a generator produces excessive output on an application, the procedure for determining whether the trouble is in the generator, regulator or elsewhere is outlined in the QUICK CHECK section of the applicable regulator bulletin. If the generator output remains high, even with the "F" terminal lead disconnected, then the trouble is in the generator itself and it must be further analyzed to locate the source of trouble. The procedure to follow depends upon the type of generator-regulator circuit the system uses. As was explained on page 4 of Bulletin 1G-100, there are two basic circuits involved which differ essentially in the part of the circuit in which the regulator inserts resistance to produce output regulation. In one the generator field circuit is *grounded through the regulator* while in the other the generator field circuit is *grounded internally.*

In the first system (which has the generator field circuit grounded externally) accidental internal grounding of the field circuit would prevent normal regulation so that excessive output might be produced by the generator. On this type of unit, an internally grounded field circuit which would cause excessive output may be located by use of test points connected between the "F" terminal and the generator frame. Leads should be disconnected from the "F" terminal and the brush to which the field lead is connected inside the generator should be raised from the commutator before this test is made. If the test lamp lights, the field is internally grounded. If the field has become grounded because the insulation on a field lead has worn away, repair can be made by reinsulating the lead. It is also possible to make repair where the ground has occurred at the pole shoes by removing the field coils and reinsulating and reinstalling them. A ground at the "F" terminal stud can be repaired by installing new insulating washers or bushings.

If the generator is of the type which has the field circuit *internally grounded,* about the only cause of excessive output (with lead disconnected from the generator "F" terminal) would be a short between the field circuit and the insulated main circuit. This can be corrected by relocating and reinsulating the leads.

Third-brush generators will produce excessive output if the third-brush position is too far advanced in the direction of armature rotation. This can be corrected by checking generator output and readjusting the third brush as described above (page 2). Excessive resistance in the charging circuit on unregulated third-brush generators under certain conditions will have the effect of increasing generator voltage and therefore generator output.

> NOTE: If battery temperature is excessive, battery overcharge is apt to occur, even though regulator settings are normal. Under this condition, it is permissible to reduce the voltage regulator setting as explained in the applicable bulletin pertaining to the regulator used on the application.

NOISY GENERATOR

Noise emanating from a generator may be caused by a loose mounting, drive pulley or gear, worn or dirty bearings, or improperly seated brushes. Dirty bearings may sometimes be saved by cleaning and relubrication, but worn bearings should be replaced. Brushes can be seated as explained on page 4). If the brush holder is bent, it may be difficult to reseat the brush so that it will function properly without excessive noise. Such a brush holder will require replacement.

POLARIZING GENERATOR

After a generator has been repaired and reinstalled on a vehicle or at any time after a generator has been tested, it must be repolarized to make sure that it has the correct polarity with respect to the battery it is to charge. Failure to repolarize the generator may result in burned relay contact points, a run-down battery and possibly serious damage to the generator itself. The procedure to follow in correcting generator polarity depends upon the generator-regulator wiring circuits—that is, whether the generator field is internally grounded or is grounded through the regulator.

PROCEDURE FOR TYPE WITH FIELD EXTERNALLY GROUNDED OR WITHOUT REGULATOR

Connect a jumper lead momentarily between the ARMATURE and BATTERY terminals of the relay or regulator after all leads have been reconnected but before the engine is started. This allows a momentary surge of current to flow through the generator which correctly polarizes it.

PROCEDURE FOR TYPE WITH FIELD INTERNALLY GROUNDED (HEAVY-DUTY TYPE)

After all leads are reconnected, disconnect the lead from the FIELD terminal of the regulator and momentarily touch this lead to the regulator BATTERY terminal. This allows a momentary surge of current to flow through the generator field coils so that the generator is correctly polarized.

NOTE: Determine the type generator before attempting to repolarize it since *using the wrong polarizing procedure will result in reversed generator polarity* and the above-mentioned serious damage to the electrical equipment.

DISASSEMBLY, REPAIR AND REASSEMBLY

The disassembly procedure to be followed will vary considerably according to the generator construction. Following pages discuss and illustrate various disassembly and reassembly procedures to be followed on various types of generator. Normally, disassembly should proceed only so far as is necessary to make repair or replacement of the defective parts. For example, the field coils should be checked for opens, shorts or grounds before being removed from the field frame: they should be removed only if they require repair or replacement (page 11).

THIRD-BRUSH GENERATOR

Figure 4 illustrates an exploded view of a third-brush, enclosed-type generator on which a step-voltage control is mounted. Disassembly procedure is simple on this type unit. Detach step-voltage control, remove cover band, disconnect insulated brush and third-brush leads from brush holders, unscrew through bolts and remove commutator end frame and field frame. The armature now can be placed in a vise (use soft jaws and avoid excessive tightening of the vise) so that pulley nut, pulley and drive end frame can be taken off the armature shaft. Reassembly is the reverse of disassembly.

There are two common types of commutator end frame construction used on third-brush generators and exploded views of these two types are shown in Figures 5 and 6. The construction shown in Figure 5 uses swivel type brush holders while that shown in Figure 6 uses reaction type brush holders. These two illustrations can be followed as a guide in the disassembly and reassembly procedure.

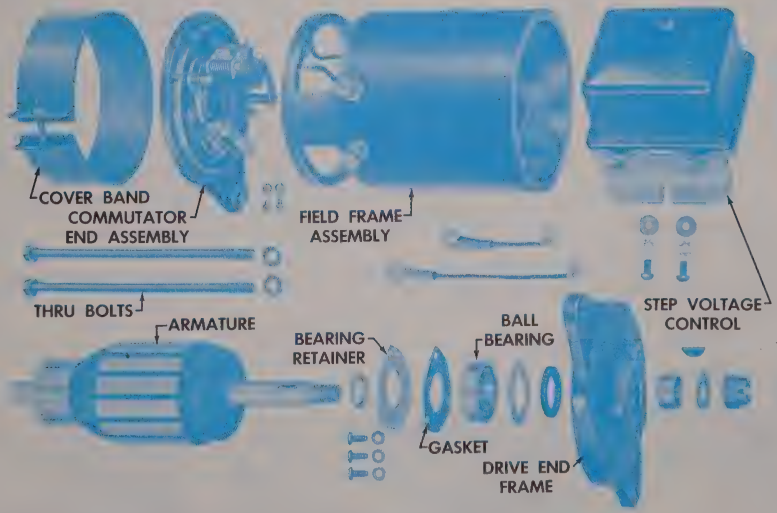


Figure 4—Disassembled view of a third-brush generator with step-voltage control.

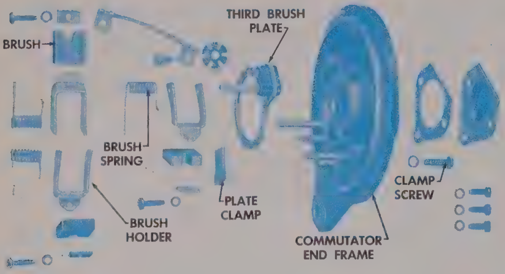

THIRD BRUSH PLATE
BRUSH
BRUSH SPRING
PLATE CLAMP
BRUSH HOLDER
CLAMP SCREW
COMMUTATOR END FRAME

Figure 5—Disassembled view of third-brush generator commutator end frame using swivel-type brush holders.

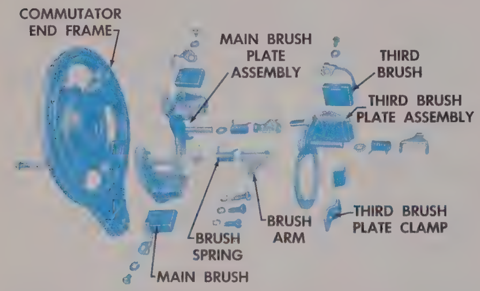

COMMUTATOR END FRAME
MAIN BRUSH PLATE ASSEMBLY
THIRD BRUSH
THIRD BRUSH PLATE ASSEMBLY
BRUSH ARM
THIRD BRUSH PLATE CLAMP
BRUSH SPRING
MAIN BRUSH

Figure 6—Disassembled view of third-brush generator commutator end frame using reaction-type brush holders.

FIELD COIL REMOVAL

Field coils can be removed from the field frame most easily by use of a pole shoe screw driver (Fig. 19). It is also advisable to use a pole shoe spreader as illustrated since this prevents distortion of the field frame. The pole shoe screw driver permits easy loosening and removal of the pole shoe screws so that the pole shoes and field coils can be taken out of the field frame. The pole shoe screw driver and spreader should be used on reassembly of the field frame. Careful reassembly is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place.

TWO-BRUSH, SHUNT GENERATORS

Figure 7 is an exploded view of a typical two-brush, shunt-type passenger car generator in completely disassembled view. The disassembly procedure is similar to that discussed for the unit shown in Figure 4. Figure 7 can be used as a guide in the disassembly procedure. Field coils are removed as already explained.

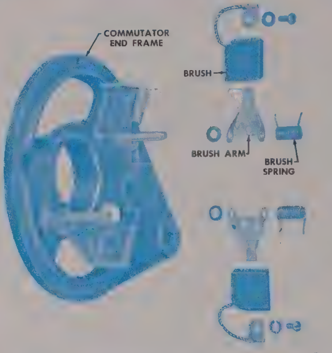

COMMUTATOR END FRAME
BRUSH
BRUSH ARM
BRUSH SPRING

Figure 8—Disassembled view of two-brush, shunt generator commutator end frame which has reaction type brush holders riveted to frame.

Figure 8 illustrates a commutator end construction often used on the type generator illustrated in Figure 7. The brush holders are of the reaction type and are riveted permanently to the commutator end frame so that the end frame and brush holders are serviced together. One brush holder is insulated from and the other is grounded to the end frame.

Figure 9 illustrates the construction of a commutator end frame and brush plate assembly used on many generators of the type shown in Figure 7. With this construction the brush plate assembly is removable from the commutator end frame.

Figure 10 is a disassembled view of a heavy-duty, 5⅝ inch frame diameter generator for special applications. Notable design features in this unit are the long frame and the location of the brush holder assemblies which are mounted individually on the walls of the field frame. This location greatly simplifies disassembly of the generator. By removal of the two thru bolts, the end frames, bearings, and armature can be disassembled or replaced without disturbing any electrical connections. Each brush holder can be disassembled by removing two attaching screws and nuts. Field coils are disassembled as described under FIELD COIL REMOVAL.

Another design for special applications is the so-

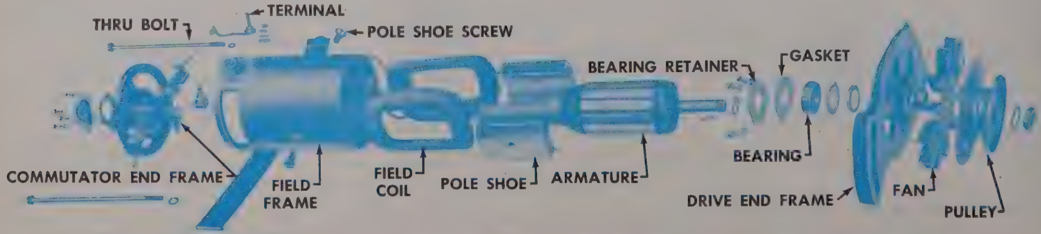

THRU BOLT
TERMINAL
POLE SHOE SCREW
BEARING RETAINER
GASKET
BEARING
COMMUTATOR END FRAME
FIELD FRAME
FIELD COIL
POLE SHOE
ARMATURE
DRIVE END FRAME
FAN
PULLEY

Figure 7—Fully exploded view of two-brush, shunt-type generator such as is used on passenger cars.

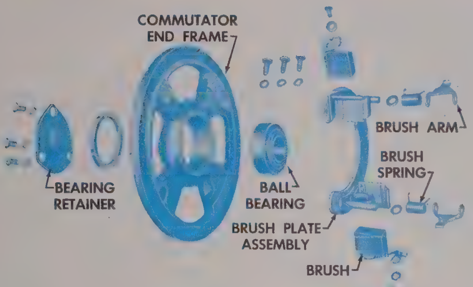

COMMUTATOR END FRAME
BRUSH ARM
BRUSH SPRING
BEARING RETAINER
BALL BEARING
BRUSH PLATE ASSEMBLY
BRUSH

Figure 9—Disassembled view of a two-brush, shunt generator commutator end frame with detachable brush plate assembly and reaction-type brush holders.

called "long frame" generator which is very similar in construction to the unit shown in Figure 7. However, the longer frame permits the use of larger field coils and a longer armature. A wider commutator and wide heavy-duty brushes give added service life. Figure 11 is a disassembled view of the commutator end frame assembly of the long frame generator.

HEAVY-DUTY, THIRD-BRUSH GENERATOR

Figure 12 is a disassembled view of a heavy-duty, third-brush generator of a somewhat different construction from the ones discussed in the foregoing paragraphs. The commutator end frame and drive end frame are attached to the field frame by hex-head screws and lock washers. On some generators of this type construction, tang-type lock washers are

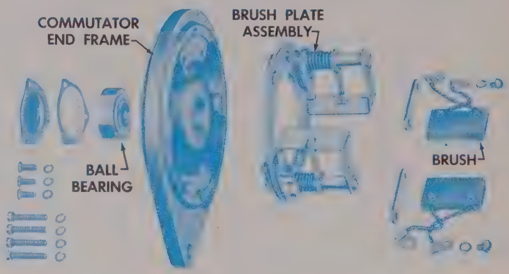

COMMUTATOR END FRAME
BRUSH PLATE ASSEMBLY
BALL BEARING
BRUSH

Figure 11—Disassembled view used in "long frame" generator.

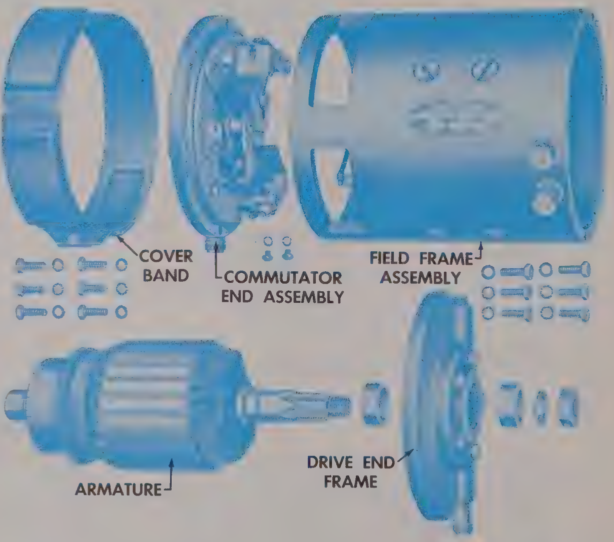

COVER BAND
COMMUTATOR END ASSEMBLY
FIELD FRAME ASSEMBLY
ARMATURE
DRIVE END FRAME

Figure 12—Disassembled view of a heavy-duty, third-brush generator

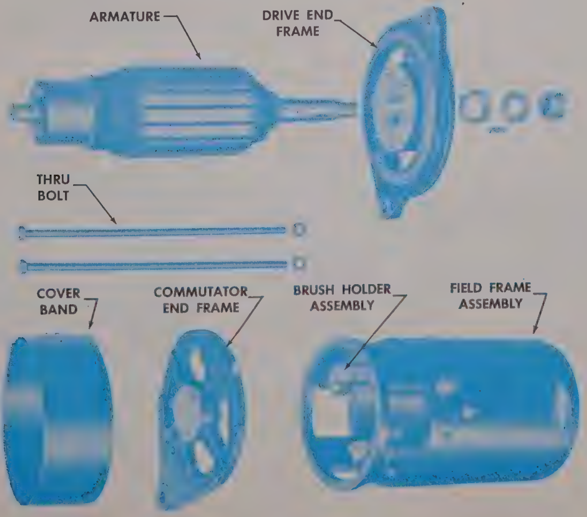

ARMATURE
DRIVE END FRAME
THRU BOLT
COVER BAND
COMMUTATOR END FRAME
BRUSH HOLDER ASSEMBLY
FIELD FRAME ASSEMBLY

Figure 10—Disassembled view of a heavy-duty, 5⅝ inch frame diameter generator.

used as added assurance against loosening of the screws. Where these are used, it is recommended that new tang lock washers be installed on reassembly since it is not safe to use them more than once. The disassembly procedure on this unit is similar to that used on other generators. After the attaching screws are removed, the commutator end frame and field frame can be detached, the armature placed in a vise and the pulley nut, pulley and drive end frame taken off the armature shaft. Field coils are removed as already explained (page 6).

Figure 13 illustrates the construction of the commutator end frame assembly used in the generator shown in Figure 12. The brush holders are of the built-up reaction type similar to those shown in Figure 16.

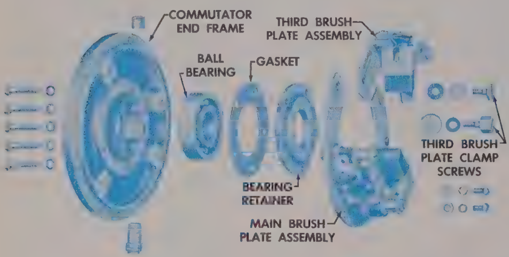

COMMUTATOR END FRAME
THIRD BRUSH PLATE ASSEMBLY
BALL BEARING
GASKET
THIRD BRUSH PLATE CLAMP SCREWS
BEARING RETAINER
MAIN BRUSH PLATE ASSEMBLY

Figure 13—Disassembled view of the commutator end frame used in the generator shown in Figure 12.

HEAVY-DUTY, FOUR-BRUSH GENERATOR WITH AIR FILTER

Figure 14 is an exploded view of a heavy-duty, four-brush, shunt generator of the type using an air filter mounted on the commutator end frame. Disassembly of this unit is carried out by removing the screws attaching the commutator end frame and the drive end frame to the field frame so that the commutator end frame and field frame can be removed. The armature can then be placed in a vise so that the pulley nut, pulley and drive end frame can be taken off the armature shaft. The field coils can be removed from the field frame as already explained (page 6).

Figure 15 is an exploded view of the commutator end frame used in the generator shown in Figure 14. This illustration can be used as a guide in the disassembly and reassembly of the commutator end frame while Figure 16 can be used as a guide in the disassembly and reassembly of the brush plate assembly. Adjustment of the brush plate and brushes with reference to the neutral point must be made after the generator is reassembled as explained on page 12.

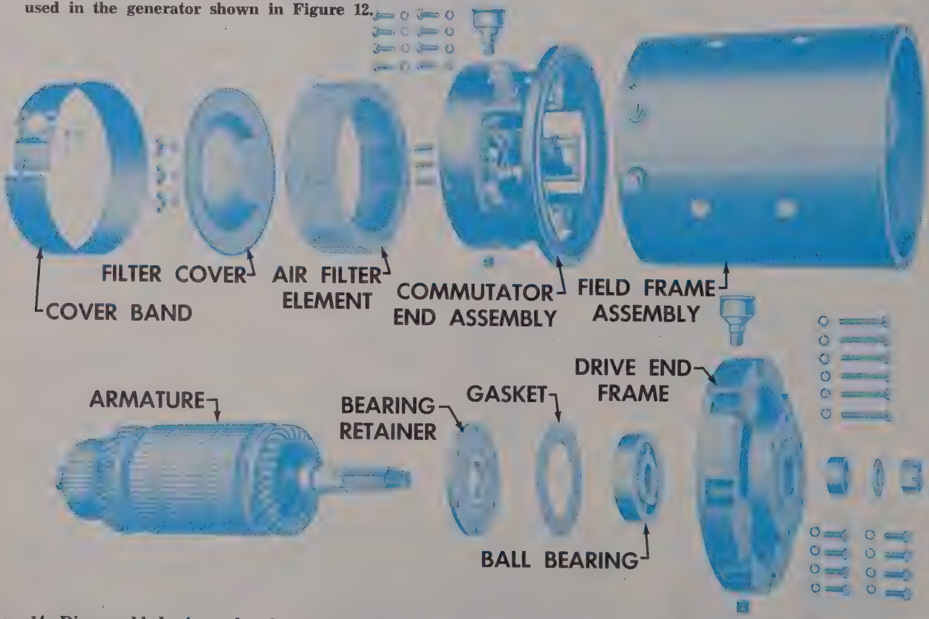

FILTER COVER
COVER BAND
AIR FILTER ELEMENT
COMMUTATOR END ASSEMBLY
FIELD FRAME ASSEMBLY
DRIVE END FRAME
ARMATURE
BEARING RETAINER
GASKET
BALL BEARING

Figure 14—Disassembled view of a heavy-duty, four-brush, shunt generator which uses an air filter element mounted on the commutator end frame.

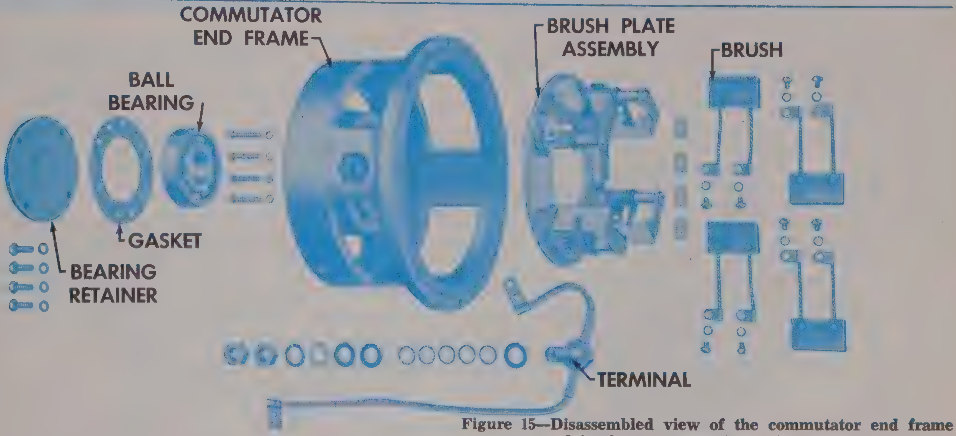

COMMUTATOR END FRAME
BRUSH PLATE ASSEMBLY
BRUSH
BALL BEARING
GASKET
BEARING RETAINER
TERMINAL

Figure 15—Disassembled view of the commutator end frame used in the generator shown in Figure 14.

HEAVY-DUTY, FOUR-BRUSH GENERATOR

Figure 17 is a sectional view of a heavy-duty, four-brush, shunt generator which requires a somewhat different disassembly procedure because of certain differences in construction. It will be noted that the inner race of the ball bearing at the commutator end frame is held on the armature shaft by a nut and cotter pin while a roller bearing is used in the drive end. Before the commutator end frame can be removed, it is necessary to take off the ball-bearing retainer plate so that the cotter pin can be withdrawn and the nut taken off the end of the armature shaft. The pulley hub can be gripped in the soft jaws of a vise to hold the shaft stationary while the nut is being backed off. Do not damage the hub. The remainder of the disassembly procedure is basically the same as that already covered on other heavy-duty units already mentioned.

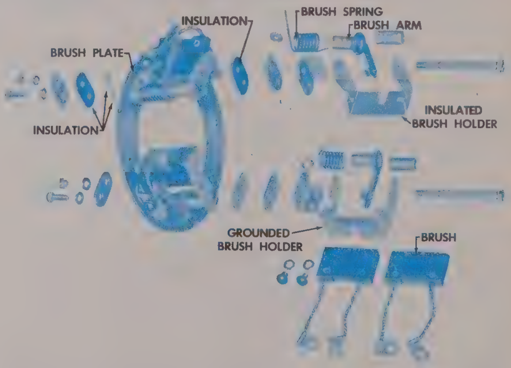

INSULATION
BRUSH SPRING
BRUSH ARM
BRUSH PLATE
INSULATION
INSULATED BRUSH HOLDER
GROUNDED BRUSH HOLDER
BRUSH

Figure 16—Partially disassembled view of the brush plate assembly used in the generator shown in Figure 14. This construction is typical of built-up brush holders.

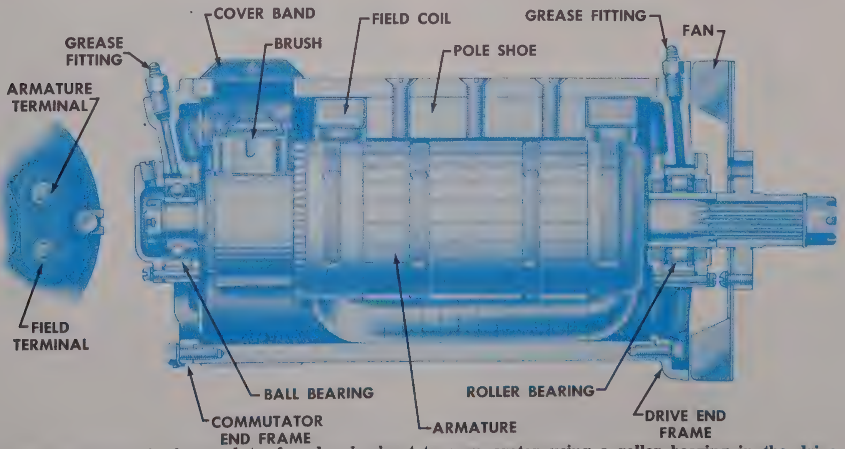

COVER BAND
FIELD COIL
GREASE FITTING
FAN
GREASE FITTING
BRUSH
POLE SHOE
ARMATURE TERMINAL
FIELD TERMINAL
BALL BEARING
ROLLER BEARING
COMMUTATOR END FRAME
ARMATURE
DRIVE END FRAME

Figure 17—Sectional view of a heavy-duty, four-brush, shunt-type generator using a roller bearing in the drive end and ball bearing in the commutator end.

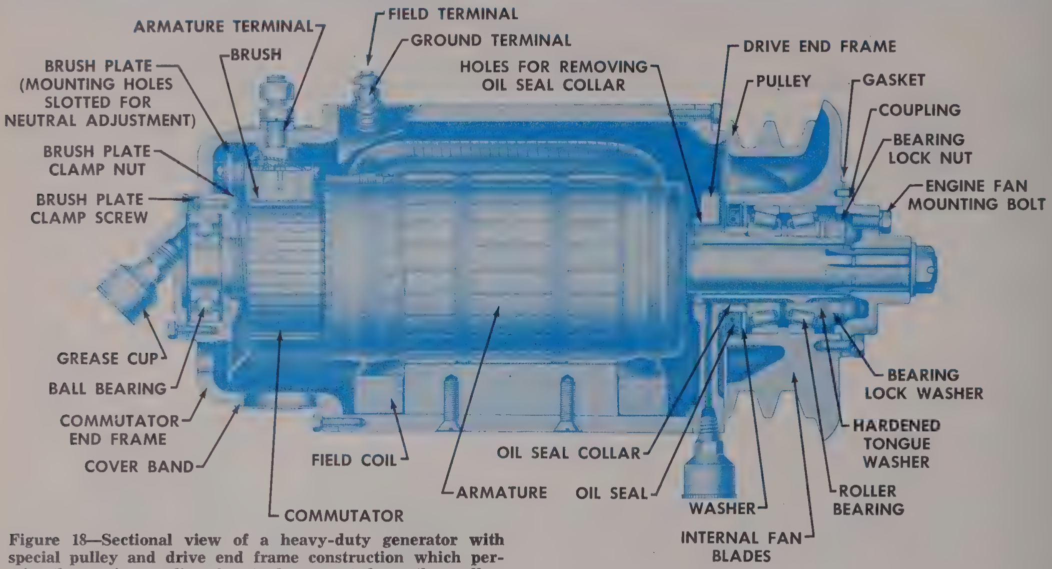

ARMATURE TERMINAL
FIELD TERMINAL
GROUND TERMINAL
BRUSH
BRUSH PLATE (MOUNTING HOLES SLOTTED FOR NEUTRAL ADJUSTMENT)
BRUSH PLATE CLAMP NUT
BRUSH PLATE CLAMP SCREW
HOLES FOR REMOVING OIL SEAL COLLAR
DRIVE END FRAME
PULLEY
GASKET
COUPLING
BEARING LOCK NUT
ENGINE FAN MOUNTING BOLT
GREASE CUP
BALL BEARING
COMMUTATOR END FRAME
COVER BAND
FIELD COIL
COMMUTATOR
ARMATURE
OIL SEAL COLLAR
OIL SEAL
WASHER
INTERNAL FAN BLADES
ROLLER BEARING
HARDENED TONGUE WASHER
BEARING LOCK WASHER

Figure 18—Sectional view of a heavy-duty generator with special pulley and drive end frame construction which permits the engine cooling fan to be mounted on the pulley.

HEAVY-DUTY GENERATOR WITH SPECIAL PULLEY CONSTRUCTION

Figure 18 is a sectional view of a heavy-duty generator of a somewhat special construction in which the engine cooling fan is supported on the generator drive pulley. To disassemble the pulley, remove the castellated nut from the armature shaft, pull the coupling off the spline, take off the bearing lock nut and the lock and tongue washers so that the pulley can be taken off the shaft with a puller. The outside roller bearing (both races and rolls) and the outer race of the inside roller bearing will come out with the pulley. In addition, the oil seal which is staked in place in the pulley and the oil seal washer will sometimes come out with the pulley and bring the inner race and rollers of the inside bearing with it. If the inner race and rollers do not come out, remove them by taking off the drive end frame, placing it in an arbor press and using two pieces of drill rod through the two holes to push the oil seal collar and inner race off. The outer races may be taken out of the pulley in an arbor press.

A specific reassembly procedure must be used in reassembling the pulley so that the proper clearances will be obtained in the roller bearings. Proceed as follows:

1. Press the oil seal collar into place on the drive end frame with an arbor press, using a piece of steel tubing 1 13/16 inch inner diameter and 3 inches long.
2. With two outer bearing races in place in the pulley, drop the inner race and rollers of the inside bearing in place in the pulley.
3. Put the oil seal washer in place and press the oil seal into the pulley. Stake it in place at approximately six points.
4. Place the pulley in position above the end frame in an arbor press and with a piece of steel tubing 1 13/16 inch inner diameter and 3 inches long, force the inner race of the bearing down firm against the oil seal collar. It is not recommended that the pulley be forced on by pressure against the pulley face, as this places considerable thrust through the rolls and might cause damage to the races.
5. The inner race of the outside bearing may now be pressed on.
6. Put on the hardened steel tongue washer and the bearing nut lock washer and tighten the bearing locknut down tight until there is no pulley end play. Assemble end frame to field and frame assembly.
7. Since there must be .004 inch end play, the bearing lock nut must now be backed out about 1/12 turn. The special lock nut and lock washer are designed to provide a convenient method of measuring 1/12 turn. Note the notch in the lock nut which comes nearest to registering with one of the tangs on the lock washer. Then back out the nut until this notch registers with the nearest tang. This will require approximately 1/12 turn, unless the notch turns out into one of the quarter sections of the lock washer which does not have tangs. In this case, go to the next notch (in clockwise direction) and turn nut until this notch registers with first tang.

8. Use an indicator to measure the end play of the pulley. Indicate from the pulley face or edge to the threaded end of the drive end frame. An end play of .004 inch is just enough to be felt when the pulley is firmly seized and pushed and pulled. This adjustment must be made correctly to provide proper clearance for the rolls in the bearings.
9. Bend tang down into notch of locking nut after securing the .004 inch end play. It may be necessary to turn nut in or out slightly—going to the opposite side of the nut for a tang and notch to register.
10. Remove the drive end grease cup and with a high pressure greaser, force high melting point grease into the grease passage until it begins to appear at the rolls.
11. Partially fill the coupling with grease. Avoid over-greasing as packing the bearings solid with grease will cause them to run hot.
12. Complete assembly of armature, coupling and castellated nut. Be sure gasket is in place under the coupling.

INSPECTION AND REPAIR OF PARTS

The armature or field should not be cleaned in any degreasing tank or by use of degreasing compounds since this might damage insulation so that a short or ground would subsequently develop. Ball bearings should be thoroughly cleaned and repacked with high melting point ball-bearing grease in accordance with bearing manufacturer's recommendation. Sealed ball bearings do not, of course, require cleaning or relubrication. Other generator parts should be cleaned and carefully inspected for wear and other damage. Any defective parts should be repaired or replaced. On reassembly all soldered electrical connections should be made with rosin flux. Acid flux must never be used on electrical connections.

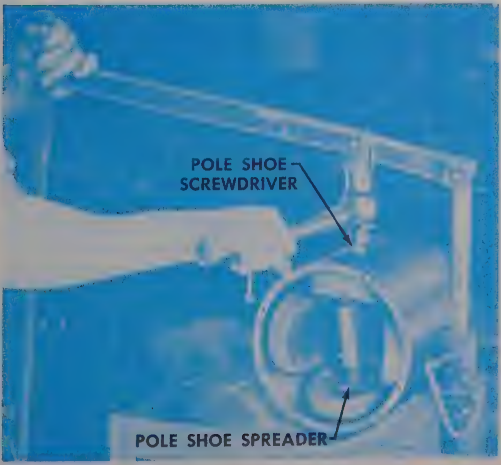


Figure 19—Using pole shoe spreader and pole shoe screw driver.

FIELD COIL SERVICE

The field coils should be checked for grounds, opens or shorts as already explained (see paragraphs 1 to 3 under NO OUTPUT, page 3).

Grounded field coils may sometimes be repaired by removing them so they can be reinsulated. Care must be used to avoid excessive bulkiness when applying new insulation since this might cause the pole shoe to cut through and cause another ground when the coils are reinstalled.

Usually, if a field coil is open or shorted internally, it will require replacement since it is difficult to repair such a defect.

To remove or replace field coils in the field frame, use a pole shoe spreader and screw driver (Fig. 19).

ARMATURE SERVICE

The armature should be checked for opens, shorts and grounds as explained in following paragraphs. If the armature commutator is worn, dirty, out of round, or has high mica, the armature should be put in a lathe (Fig. 20) so the commutator can be turned down and the mica undercut. The mica should be undercut 1/32 of an inch and the slots cleaned out carefully to remove any trace of dirt or copper dust. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any slight burrs that might be left as a result of the undercutting procedure.

Open circuited armatures can often be saved, where the open is obvious and repairable. The most likely place an open will occur is at the commutator riser bars: this usually results from overloading of the generator which causes overheating and melting of the solder. Repair can be effected by resoldering the leads in the riser bars (using rosin flux) and turning down the commutator in a

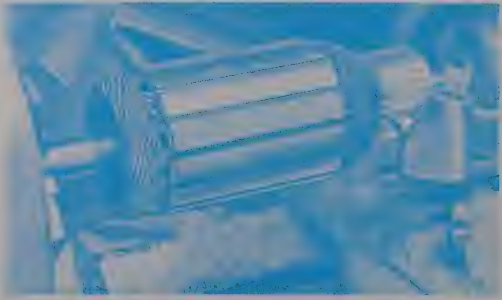


Figure 20—Generator armature set up in lathe so commutator can be turned down.

lathe to remove the burned spot and then undercutting the mica as explained in the previous paragraph. In some heavy-duty armatures, the leads are welded into the riser bars and these cannot, of course, be repaired by resoldering.

Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler, with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short is located. Copper or brush dust in the slots between the commutator bars sometimes causes shorts between bars which can be eliminated by cleaning out the slots. Shorts at cross-overs of the coils at the core end can often be eliminated by bending wires slightly and reinsulating the exposed bare wire.

Grounds in the armature are detected by use of a test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure which is often brought on by overloading and consequent overheating of the generator. Repairs can sometimes be made, if grounds are at core ends (where coils come out of slots) by placing insulating strips between core and coil which has grounded.

CHECKING AND ADJUSTING NEUTRAL POINT

Many of the higher output shunt generators have adjustable brush plates which can be shifted to obtain the proper brush locations with respect to the neutral point. Proper adjustment is necessary in order to obtain best commutation and therefore maximum brush and commutator life. The neutral point refers to a particular relationship between the field coils, armature windings and brushes. When the relationship of these parts is correct, minimum arcing and best commutation will be obtained. Whenever new brushes, armature, or field coils are installed, or whenever a generator has been disassembled and reassembled, the brush position must be checked and adjusted as follows (provided, of course, that the brush ring is adjustable):

With the generator assembled and the brush ring attaching screws just tight enough to hold the brush ring in place in the commutator end frame, connect a battery between the generator "A" terminal and ground (or between the "A+" and "A-" terminals on insulated units) and note the tendency for the armature to rotate. The generator should be on a test bench with the armature free to rotate and without any connection to the generator field terminal. The voltage to use in making this check is the minimum amount of voltage which will cause the armature to rotate when it is free to turn. This voltage may be obtained by starting with one battery cell and then adding more cells until a high enough voltage is obtained. Or a variable resistance may be connected into the circuit from the battery. The neutral point is found by shifting the brushes into the position at which there is no tendency for the armature to rotate in either direction. Then after the neutral point is located, the brushes should be shifted slightly ahead in the direction of armature rotation so that the armature will tend to rotate very slowly in the direction of the generator's normal driven rotation. After this brush position is found, the brush plate locking or attaching screws should be tightened securely.

WIRING, INSULATION AND FUSING

Fuses of the proper current-carrying capacity should be installed in the charging and accessory circuits wherever required to protect equipment against damage from excessive overloading or from accidental short circuits or grounds.

All connections in the charging circuit must be clean and tight as loose connections and corroded joints cause high resistance and may result in serious damage to equipment due to excessive voltage. ALL SOLDERED JOINTS SHOULD BE MADE WITH ROSIN FLUX—NEVER USE ACID FLUX ON ELECTRICAL CONNECTIONS.

In wiring a motor coach or truck stranded wire must be used to minimize breakage due to vibration. All wiring should be supported at enough points to prevent any motion since looseness would cause chafing and wear of the insulation.

For 24- and 32-volt systems extra heavily insulated wire must be used to protect against the higher voltage. Failure to insulate the wiring properly may result in serious damage due to the great amount of power available from the battery.

Terminals at the ends of wires must have ample current-carrying capacity and must be sufficiently strong to withstand vibration. Wires should be supported as close to terminals as possible.

Whenever generator wiring is installed, wire of sufficiently large size must be used to carry the maximum current the length of the circuit without excessive voltage drop. In two-wire insulated systems, the total length of wire in the circuit must be taken into account. Smaller wire can be used in the generator field circuit since the current carried is comparatively small, being only about one to three amperes depending upon the voltage of the system.

Due to mechanical reasons wire smaller than number 14 B. & S. should never be used. Always use stranded wire in all circuits to minimize danger of breakage due to vibration.

DELCO-REMY
SERVICE BULLETIN

BULLETIN 1M-150
Date 3-2-49
13 Pages Page 1
File Under:
M-CRANKING MOTORS
Supersedes Bulletins
1M-150, Dated 1-16-47
and
1M-155, Dated 3-1-38

ADJUSTMENTS, TESTS AND MAINTENANCE OF CRANKING MOTORS

The best assurance of obtaining maximum service from cranking motors with minimum trouble is to follow a regular inspection and maintenance procedure. Periodic lubrication where required, inspection of the brushes, commutator and drive arrangement are essentials in the inspection procedure. In addition, disassembly and thorough overhauling of the cranking motor at periodic intervals are desirable as a safeguard against road failures from accumulations of dust and grease and from normal wear of parts. This is particularly desirable on commercial vehicles where maintenance of operating schedules is of especial importance. In addition to the cranking motor itself, the external circuit between the cranking motor and the battery must be kept in good condition since defective wiring, loose or corroded connections will prevent normal cranking action. Also, the solenoid or magnetic switch, on cranking motors so equipped, should be periodically checked as outlined in Bulletin 1S-120. The series-parallel system used with some heavy-duty cranking motors is covered in Bulletin 1S-130. On solenoid operated overrunning clutch or Dyer drive cranking motors, the drive pinion clearance or travel must be checked as explained in following paragraphs.

CRANKING MOTOR MAINTENANCE

LUBRICATION

Bearings provided with hinge cap oilers should have 8 to 10 drops of light engine oil every 5,000 miles. Grease cups should be turned down one turn every 5,000 miles and refilled with medium cup grease when required. On tractor, marine, or stationary applications, lubricate every 300 hours of operation as above. Grease plugs on gear reduction cranking motors should be removed every six months so the grease reservoir can be repacked with medium grade graphite grease.

On some models, oil wicks are used to lubricate the center and drive end bushings. The wicks are saturated with oil before assembly, and should be saturated again whenever the cranking motor is taken off the engine or disassembled.

Some cranking motors are equipped with oilless bushings. These should be supplied with a few drops of light engine oil at any time that the cranking motor is disassembled for repair or service.

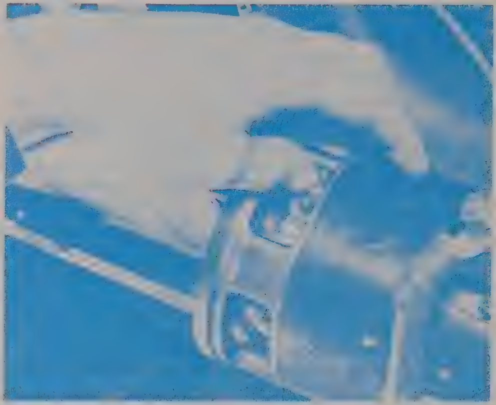


Figure 1—Inspecting cranking motor brushes and commutator.

Avoid excessive lubrication since this might cause lubricant to be forced out onto the commutator where it would gum and cause poor commutation with a resulting decrease in cranking motor performance.

LUBRICATING DRIVE MECHANISM

Bendix drives and Dyer drives should be lubricated with a small amount of light engine oil whenever the cranking motor is removed from the engine for servicing. Heavy oil or grease must not be used as this may retard or prevent normal action of the drive mechanism. The overrunning clutch drive is packed with lubricant during original assembly and requires no additional lubrication.

Never lubricate the commutator and do not attempt to lubricate the cranking motor while it is being operated. Be sure to keep grease or oil clean. Lubricant should be kept in closed containers.

INSPECTION

At periodic intervals the cranking motor should be inspected to determine its condition. The frequency with which this should be done will be determined by the type and design of cranking motor as well as the type of service in which it is used. Frequent starts, as in city operation or door-to-door delivery service, excessively long cranking periods caused by a hard-starting engine condition, excessively dirty or moist operating conditions, heavy vibration, all will make it necessary that the inspection checks be made at more frequent intervals. Generally speaking, passenger car and other standard-duty cranking motors should be inspected at approximately 5,000 mile intervals. Heavy-duty units may not require as frequent inspection. However, where special operating conditions such as outlined above exist, inspection at more frequent intervals may be required.

INSPECTION PROCEDURE

Cranking motor action is indicative, to some extent, of the cranking motor condition. Thus, a cranking motor that responds normally when the cranking motor switch is closed is usually considered to be in good condition. (Checking a cranking motor that does not operate normally is discussed in a following section.) However, the inspection procedure should include more than a mere check of the cranking motor operation; the following items should also be inspected. The mounting, wiring and connections should be tight and in good condition. The magnetic switch or solenoid (where used) should be firmly mounted and should operate freely and without binding.

Next, remove the cover band (Fig. 1) so the commutator, brushes and internal connections can be checked. Examine the cover band for thrown solder (Fig. 2) which results if the cranking motor is subjected to excessively long cranking periods so it overheats. This overheating causes the solder at the commutator riser bars to melt and be thrown out during cranking. Bad connections consequently develop which in turn result in arcing and burning of the commutator bars and ultimate ruination of the armature. If the bars are not too badly burned, the armature can often be saved by resoldering the connections at the riser bars (using rosin, not acid, flux), turning the commutator (Fig. 22) and undercutting the mica between bars. Some cranking motor armatures are of the welded construction, with the armature coil leads welded, not soldered, to the commutator bars. This type of armature should not be repaired by ordinary soldering methods.

> NOTE: Regardless of the type of construction, never operate the cranking motor more than 30 seconds at a time without pausing to allow the cranking motor to cool off for at least two minutes. Overheating, caused by excessively long cranking periods, may seriously damage the cranking motor.

When checking the brushes, make sure they are not binding and that they are resting on the commutator with sufficient tension to give good, firm contact. Brush leads and screws should be tight. If the brushes are worn down to one-half their original length, (compare with new brushes) they should be replaced.

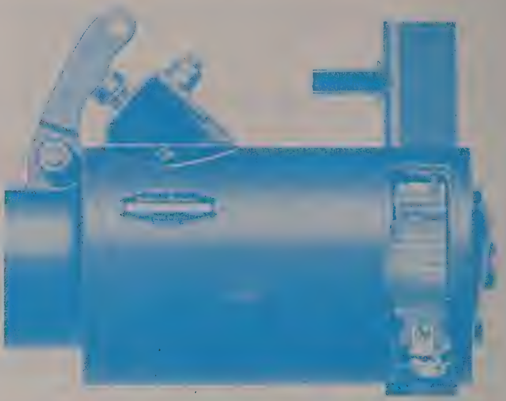


Figure 2—Thrown solder on cover band as shown by arrow indicates overheating of the cranking motor as a result of excessively long cranking periods.

Note the condition of the commutator. If it is glazed or dirty, it can be cleaned in a few seconds by holding a strip of number 00 sandpaper against it with a piece of wood while the cranking motor is operated (Fig. 3). A brush seating stone can also be used for this purpose. Move the sandpaper or stone back and forth across the commutator while the armature is spinning. Never operate the cranking motor more than 30 seconds at a time without pausing for a few minutes to allow the cranking motor to cool. Blow out all dust after the commutator is cleaned.

If the commutator is rough, out of round, has high mica, or is extremely dirty, it will require turning down in a lathe (Fig. 22) and undercutting of the mica between the bars.

QUICK CRANKING-MOTOR CHECKS

When trouble develops in the cranking motor system, and the cranking motor cranks the engine slowly or not at all, several preliminary checks can be made to determine whether the trouble lies in the battery, in the cranking motor, in the wiring circuit between them, or elsewhere. Many conditions besides defects in the cranking motor can result in poor cranking performance.

To make a quick check of the cranking motor system, turn on the headlights. They should burn with normal brilliance. If they do not, the battery may be run down and it should be checked with a hydrometer (Bulletin 7D-100). If the battery is in a charged condition so the lights burn brightly, operate the cranking motor. Any one of three things will happen to the lights. They will go out, dim considerably, or stay bright without any cranking action taking place.

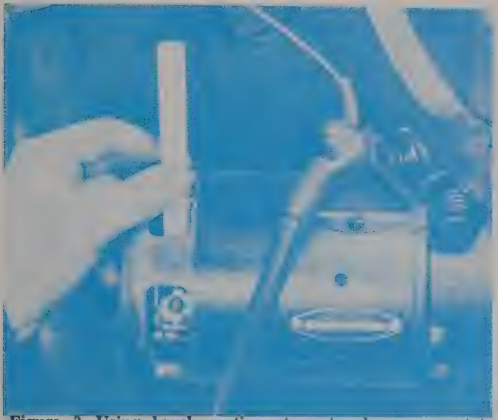


Figure 3—Using brush seating stone to clean commutator.

If the lights go out as the cranking motor switch is closed, it indicates that there is a poor connection between the battery and the cranking motor. This poor connection will most often be found at the battery terminals, and correction is made by removing the cable clamps from the terminals, cleaning the terminals and clamps, replacing the clamps and tightening them securely. A coating of corrosion-inhibitor may be applied to the clamps and terminals to retard formation of corrosion.

If lights dim considerably as the cranking motor switch is closed and the cranking motor operates slowly or not at all, the battery may be run down. Or, there may be some mechanical condition in the engine or the cranking motor that is throwing a heavy burden on the cranking motor. This imposes a high discharge rate on the battery which causes noticeable dimming of the lights. Check the battery with a hydrometer. If it is charged, the trouble probably lies in either the engine or cranking motor itself. In the engine, tight bearings or pistons, or heavy oil place an added burden on the cranking motor. Low temperatures also hamper cranking motor performance since it thickens engine oil and makes the engine considerably harder to crank and start. Also, the battery is less efficient at low temperatures. In the cranking motor, a bent armature shaft, loose pole shoe screws or worn bearings, any of which may allow the armature to drag, will reduce cranking performance and increase current draw.

In addition, more serious internal damage is sometimes found. Thrown armature windings or commutator bars, which sometimes occur on overrunning clutch type cranking motors, are usually caused by excessive overrunning after starting. This is a result of such conditions as the driver's keeping his foot on the cranking motor switch too long after the engine has started, the driver's opening the throttle too wide in starting, or improper throttle cracker adjustment. Any of these subject the overrunning clutch to extra strain so it tends to seize, spinning the armature at high speed with resulting armature damage.

On Bendix drive cranking motors, broken Bendix housings and wrapped-up Bendix springs may result if the driver closes the cranking motor switch during engine rockback after the engine starts and then stops again. Another cause may be engine backfire during cranking which may result, among other things, from ignition timing being too far advanced. To avoid such failures, the driver should pause a few seconds after a false start to make sure the engine has come completely to rest before another start is attempted. In addition, the ignition timing should be reset if engine backfiring has caused the trouble.

The third condition which may be encountered when the cranking motor switch is closed with the lights turned on is that the lights stay bright, but no cranking action takes place. This indicates an open circuit at some point, either in the cranking motor, or in the cranking motor switch or control circuit. Where the application is solenoid-operated, the solenoid control circuit can be eliminated momentarily by placing a heavy jumper lead across the solenoid main terminals to see if the cranking motor will operate. This connects the cranking motor directly to the battery and, if it operates, it indicates that the control circuit is not functioning normally. The wiring and control units must be checked to locate the trouble. If the cranking motor does not operate, it will probably have to be removed from the engine so it can be analyzed in detail.

CHECKING BATTERY-TO-CRANKING-MOTOR CIRCUIT

Excessive resistance in the circuit between the battery and cranking motor will reduce cranking performance. The resistance can be checked by using a voltmeter to measure the voltage drop in the circuits while the cranking motor is operated (Fig. 4). There are three checks to be made, (1) the voltage drop between the car frame and the grounded battery terminal post (not the terminal cable clamp); (2) the drop between the car frame and the cranking motor field frame, and (3) the drop between the insulated battery terminal post and the cranking motor terminal stud (or the battery terminal stud of the solenoid). Each of these should show no more than 0.1 volt drop with the cranking motor cranking the engine.

CAUTION: Do not use the cranking motor more than 30 seconds, to avoid overheating.

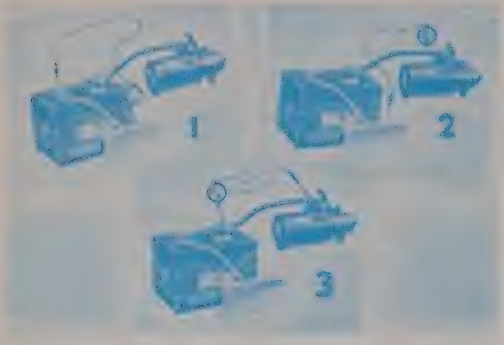


Figure 4—Checking voltage drop of cranking motor circuit with a voltmeter. Three checks are required as shown.

If excessive voltage drop is found in any of these circuits, make correction by disconnecting the cables, cleaning the connections carefully, and then reconnecting the cables firmly in place. A coating of corrosion-inhibitor on the battery terminals and cable clamps will retard corrosion.

> NOTE: On some applications, extra long battery cables are required due to locations of battery and cranking motor, and this may result in somewhat higher voltage drop than the above recommended 0.1 volt. On such applications, the normal voltage drop should be established by checking several vehicles. Then, when a voltage drop well above this normal figure is found, abnormal resistance will be indicated and correction can be made as already explained.

NO LOAD AND TORQUE TESTS

(Refer to Bulletins 1M-180 and 1M-185 for specifications)

To obtain full performance data on a cranking motor, or to determine the cause of abnormal operation, the cranking motor should be submitted to a no-load and a torque test. These tests are performed with the cranking motor removed from the engine.

In the no-load test, the cranking motor is connected in series with a battery of the specified voltage and an ammeter capable of reading several hundred amperes. An r.p.m. indicator should also be used to measure the armature revolutions per minute.

The torque test requires such equipment as is illustrated in Figure 5. The cranking motor is securely mounted and the brake arm hooked to the drive pinion. Then, when the specified voltage is applied, the torque can be computed from the reading on the scale. If the brake arm is one foot long as shown, the torque will be indicated directly on the scale in pounds feet. A high-current-carrying variable resistance should be used so that the specified voltage can be applied. Many torque testers indicate the developed pounds feet of torque on a dial.

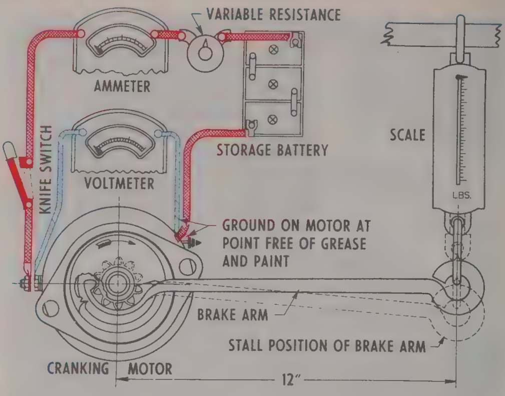


Figure 5—Diagramatic layout for cranking motor torque tester. Ammeter, and battery leads shown in red, voltmeter leads in blue.

The specifications are normally given at low voltages so the torque and ammeter readings obtained will be within the range of the testing equipment available in the field.

INTERPRETING RESULTS OF TESTS

1. Rated torque, current draw and no load speed indicates normal condition of cranking motor.
2. Low free speed and high current draw with low developed torque may result from:
   - a) Tight, dirty, or worn bearings, bent armature shaft or loose field pole screws which would allow the armature to drag.
   - b) Shorted armature. Check armature further on growler.
   - c) A grounded armature or field. Check by raising the grounded brushes and insulating them from the commutator with cardboard, and then checking with a test lamp between the insulated terminal and the frame. If test lamp lights, raise other brushes from commutator and check fields and commutator separately to determine whether it is the fields or armature that is grounded.
3. Failure to operate with high current draw:
   - a) A direct ground in the switch, terminal or fields.
   - b) Frozen shaft bearings which prevent the armature from turning.
4. Failure to operate with no current draw:
   - a) Open field circuit. Inspect internal connections and trace circuit with test lamp.

b) Open armature coils. Inspect the commutator for badly burned bars. Running free speed, an open armature will show excessive arcing at the commutator bar which is open.

c) Broken or weakened brush springs, worn brushes, high mica on the commutator, or other causes which would prevent good contact between the brushes and commutator. Any of these conditions will cause burned commutator bars.

5. Low no-load speed with low torque and low current draw indicates:

a) An open field winding. Raise and insulate ungrounded brushes from commutator and check fields with test lamp.

b) High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under 4.

6. High free speed with low developed torque and high current draw indicates shorted fields. There is no easy way to detect shorted fields, since the field resistance is already low. If shorted fields are suspected, replace the fields and check for improvement in performance.

DISASSEMBLY, REPAIR AND REASSEMBLY

The disassembly procedure to be followed will vary considerably according to the type and construction of the cranking motor. The following pages discuss and illustrate various disassembly and reassembly procedures to be followed on various types of cranking motors. Normally, disassembly should proceed only so far as is necessary to make repair or replacement of the defective parts. For example, the field coils should be checked for opens or grounds and, if found to be in normal condition, should not be removed from the field frame. Pages 12 and 13 discuss the repair and servicing of the armature, fields and other components of the cranking motor. Bulletin 1S-120 outlines the checks and servicing of magnetic switches and solenoids.

STANDARD BENDIX DRIVE CRANKING MOTOR

Figure 6 is an exploded view of a standard Bendix drive cranking motor. Some cranking motors of this type may have a magnetic switch mounted on the field frame assembly; some have a center bearing. To disassemble the cranking motor, remove the magnetic switch (where present), take off the cover band and detach brush leads from field leads. Unscrew thru bolts and take off commutator end frame and field frame assembly. Where there is a center bearing attached to the drive housing, detach it. Now, remove the armature with the Bendix drive assembled on it from the drive housing. Armature service is covered on page 12. The

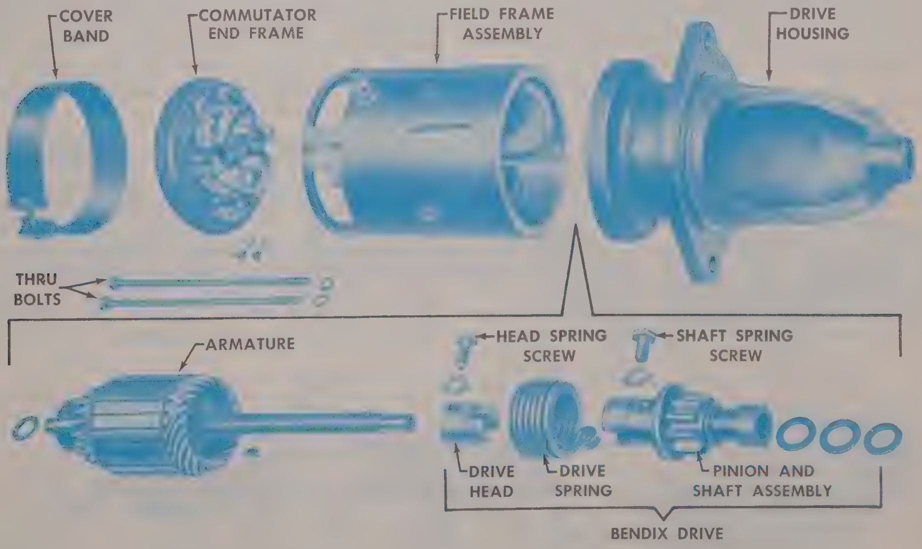


Figure 6—Disassembled view of a typical Bendix drive cranking motor.

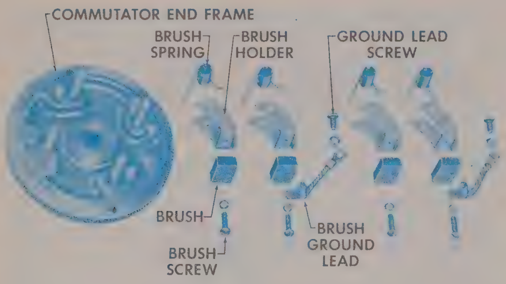


Figure 7—Disassembled view of commutator end frame using reaction type brush holders.

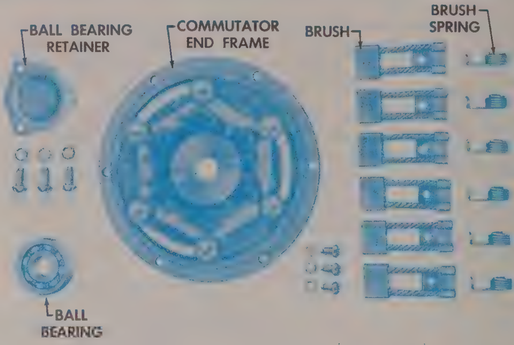


Figure 8—Commutator end with integral brush holders from which brushes are shown removed.

Bendix drive can be detached from the armature shaft by removing the head spring screw. Unscrewing the shaft spring screw permits separation of the drive spring from the drive pinion and shaft assembly. Use new tang lock washers on reassembly since repeated bending of the tang is liable to break it off.

The Bendix drive may be cleaned by washing in kerosene and then relubricated with a trace of light engine oil after reassembly. Do not use heavy oil or grease as this may retard or prevent normal drive action.

Two general types of commutator end frame are used in standard Bendix-drive cranking motors, one with detachable brush holders (Fig. 7) and the other with the brush holders riveted to the frame (Fig. 8). The former is the more commonly used. The two illustrations can be used as guides for removal of the brushes or brush holders.

FIELD COIL REMOVAL

Field coil service is covered on pages 12 and 13. Field coils can be removed from the field frame assembly most easily by use of a pole shoe screw driver such as is shown in Figure 23. A pole shoe spreader should also be used since this prevents distortion of the field frame. Careful reinstallation of the field coils is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place. On many cranking motors, long and triangular insulating strips are used to protect the field leads from grounding to the frame. These must be replaced on reassembly. Where the pole shoe has a long lip on one side and a short lip on the other, the long lip should be assembled in the direction of armature rotation so it becomes the trailing (not leading) edge of the pole shoe.

BARREL BENDIX DRIVE CRANKING MOTOR

Figure 9 shows an exploded view of a barrel Bendix drive while the type cranking motor with which this drive is commonly used is shown in Bulletin 1M-110. The cranking motor is disassembled by removing the cover band, detaching brush leads, unscrewing the commutator-end-frame and drive-end-frame attaching screws, and taking off the commutator-end-frame and field-frame assembly. Refer to Figure 7 for disassembly of the commutator end frame. Removal of the field coils has been discussed in the previous paragraph. Armature service is covered on page 12.

The Bendix drive assembly (Fig. 9) can be removed by pushing in the outer anchor plate so the pilot screw (or pin) can be removed. Some Bendix drives use a pilot pin instead of a screw. The drive itself can be disassembled as shown in Figure 9 by slipping off the anchor plates and drive spring, removing the snap ring from the inside of the barrel and separating the pinion-and-barrel assembly from the shaft assembly.

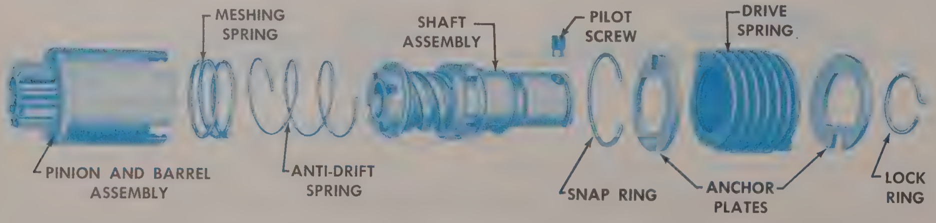


Figure 9—Disassembled view of a barrel type Bendix drive.

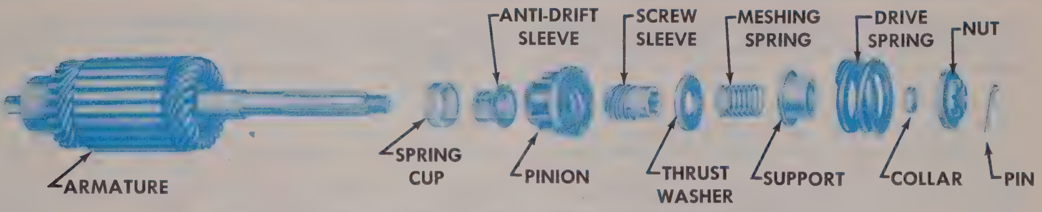

ANTI-DRIFT SLEEVE
SCREW SLEEVE
MESHING SPRING
DRIVE SPRING
NUT
ARMATURE
SPRING CUP
PINION
THRUST WASHER
SUPPORT
COLLAR
PIN

Figure 10—Disassembled view of a compression spring type Bendix drive.

COMPRESSION SPRING BENDIX DRIVE CRANKING MOTOR

Figure 10 illustrates an exploded view of a compression spring type Bendix drive while the type cranking motor with which this drive is commonly used is shown in Bulletin 1M-110. The cranking motor in which this type of drive is used is disassembled in a manner similar to that used for the barrel Bendix drive cranking motor. The drive itself is disassembled from the armature shaft by taking out the cotter pin, unscrewing the nut, and removing, in the order shown in Figure 10, the drive parts. Observe carefully the relationship of the parts when removing them so they can be reinstalled in the same relationship.

GEAR REDUCTION CRANKING MOTOR

Bulletin 1M-110 illustrates two general types of gear reduction cranking motors, while Figure 11 is an exploded view of one of these. Some cranking motors of this type may have a magnetic switch mounted on a field-frame assembly. To disassemble the cranking motor, remove the magnetic switch (where present), take off the cover band and detach the brush leads from the field leads. Then remove screws attaching the drive housing and separate drive housing from reduction gear housing. The drive shaft (with gear and Bendix drive) may then be taken out of the drive housing. Next separate the field-frame assembly from the reduction gear housing by removing the attaching screws. The armature may then be removed from the reduction gear housing. Where the gear is detachable from the armature it will be necessary to take off two nuts, the gear and Woodruff keys before separating the armature from the housing. The gear reduction housing should be repacked with medium grade graphite grease on reassembly. Armature service is covered on page 12.

The Bendix drive can be detached from the drive shaft by removing the head spring screw. (See Figure 6.)

Figures 7 and 8 illustrate two types of commutator end frames used with the gear reduction type of cranking motor. These illustrations can be used as guides for removal of the brushes or brush holders. Field coil removal has been covered on page 6.

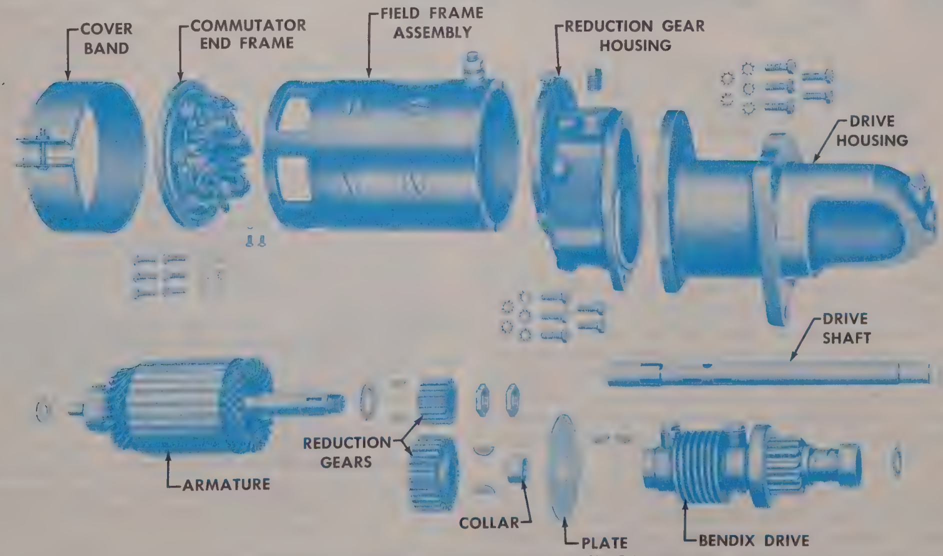

COVER BAND
COMMUTATOR END FRAME
FIELD FRAME ASSEMBLY
REDUCTION GEAR HOUSING
DRIVE HOUSING
DRIVE SHAFT
ARMATURE
REDUCTION GEARS
COLLAR
PLATE
BENDIX DRIVE

Figure 11—Disassembled view of a gear reduction type Bendix drive cranking motor.

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OVERRUNNING CLUTCH TYPE CRANKING MOTOR OPERATED BY SOLENOID WITH RELAY

Figure 12 is an exploded view of an overrunning clutch type cranking motor operated by a solenoid equipped with a solenoid relay. Functioning of the overrunning clutch is discussed in Bulletin 1M-120. Operation of the solenoid and test procedures are discussed in Bulletin 1S-120. The relay action and test procedures are covered in Bulletin 1R-100.

The cranking motor is disassembled by removing the solenoid assembly and the cover band, detaching brush leads from the field leads, withdrawing the thru bolts and then separating the commutator end frame, field-frame assembly and drive housing. Some cranking motors of this type have an intermediate bearing as shown and this can be letached from the drive housing by removing ataching screws. The shift lever, attaching parts, and he overrunning clutch may then be taken off the lrive housing. Disassembly, assembly and testing f the solenoid is outlined in Bulletin 1S-120. Renoval of the field coils has already been covered page 6). Checking and servicing of the overunning clutch is discussed on page 13. Armaure service is detailed on page 12.

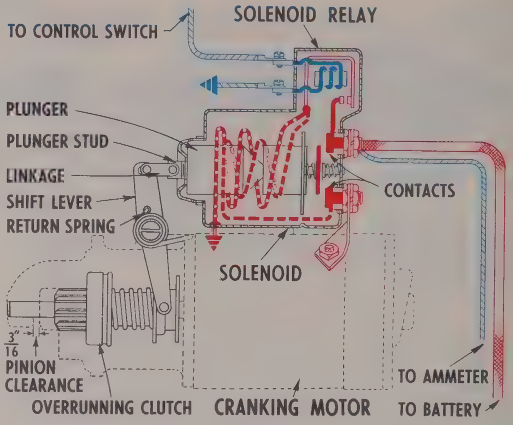
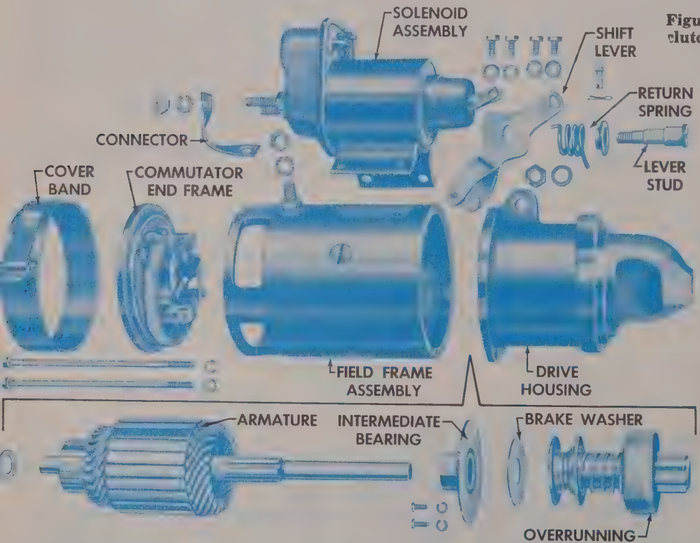

TO CONTROL SWITCH
SOLENOID RELAY
PLUNGER
PLUNGER STUD
LINKAGE
SHIFT LEVER
RETURN SPRING
CONTACTS
SOLENOID
3/16"
PINION CLEARANCE
OVERRUNNING CLUTCH
CRANKING MOTOR
TO AMMETER
TO BATTERY

Figure 13—Schematic diagram of overrunning clutch, cranking motor, and solenoid showing pinion clearance.


SOLENOID ASSEMBLY
SHIFT LEVER
RETURN SPRING
LEVER STUD
CONNECTOR
COVER BAND
COMMUTATOR END FRAME
FIELD FRAME ASSEMBLY
DRIVE HOUSING
ARMATURE
INTERMEDIATE BEARING
BRAKE WASHER
OVERRUNNING CLUTCH

igure 12—Disassembled view of an overrunning clutch type cranking motor using a solenoid.

After the cranking motor is reassembled it is ecessary to adjust the plunger stud in the solenoid lunger to make sure that there will be 3/16 inch inion clearance between the end of the drive inion and the drive housing with the pinion in the cranking position. (See Figure 13.) Clearance is checked by disconnecting the connector between the solenoid and cranking motor terminal so that the cranking motor will not operate. Then a battery of the proper voltage should be connected to the solenoid. Next, remove the solenoid relay cover and connect around the relay points with a jumper lead. Push the solenoid plunger into the solenoid by hand. Once in, battery current will hold it in place so the pinion clearance can be checked and adjusted. Adjust by detaching plunger stud linkage from shift lever and turning stud in or out of plunger as necessary.

OVERRUNNING CLUTCH TYPE CRANKING MOTOR OPERATED BY SOLENOID WITHOUT RELAY

Figure 14 is a schematic diagram of an overrunning clutch type cranking motor operated by a solenoid without a solenoid relay. Operation of the clutch and solenoid are discussed in Bulletins 1M-120 and 1S-120 respectively. A separate push button switch connects the solenoid directly to the battery, eliminating the solenoid relay.

Disassembly is similar to that of the cranking motor shown in Figure 12. Checking and servicing procedures are also similar except for the adjustment of pinion clearance. The solenoids used on cranking motors of this type do not have an adjustable stud in the solenoid plunger, and this necessitates a different adjustment procedure.

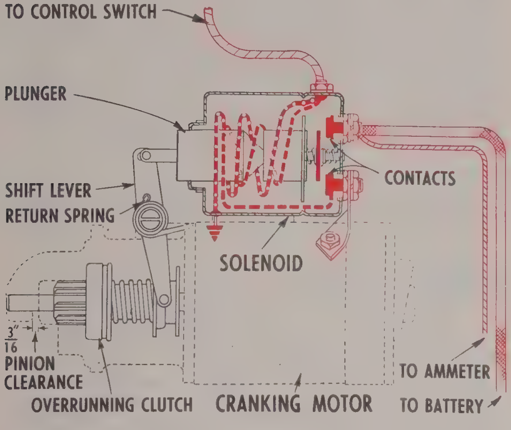

TO CONTROL SWITCH
PLUNGER
SHIFT LEVER
RETURN SPRING
CONTACTS
SOLENOID
3/16"
PINION CLEARANCE
OVERRUNNING CLUTCH
CRANKING MOTOR
TO AMMETER
TO BATTERY

Figure 14—Schematic diagram of overrunning clutch type cranking motor and solenoid (without relay) showing pinion clearance.

After the cranking motor is reassembled, the pinion clearance must be adjusted in the following manner. Clamp the cranking motor in a vise and remove the connector from the "motor" terminal of the solenoid (Fig. 15) so the cranking motor will not operate. Place a piece of 3/16 inch bar stock or a gauge between the pinion and housing. Connect a battery of the proper voltage between the "switch" terminal of the solenoid and the solenoid base (ground), and push the solenoid plunger in by hand. Battery current will hold the plunger in the "bottomed" position while the pinion clearance is adjusted. Loosen the solenoid switch mounting screws and pull the solenoid switch away from the shift lever until play is taken out of the lever and clutch mechanism. DO NOT COMPRESS OVERRUNNING CLUTCH SPRING. (Moving switch toward lever increases clearance, and moving switch away from lever decreases pinion clearance.) Tighten solenoid switch mounting screws, and replace connector at "motor" terminal of solenoid.

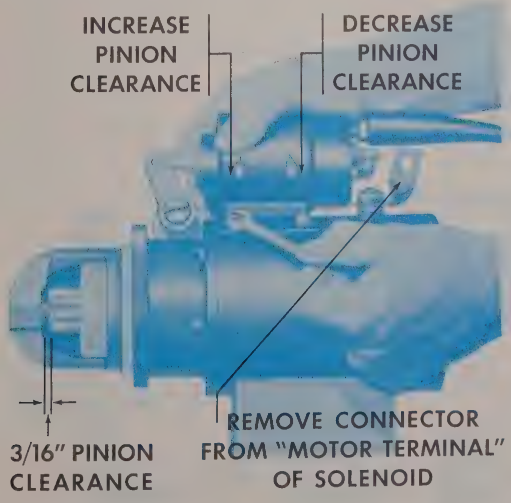

INCREASE PINION CLEARANCE
DECREASE PINION CLEARANCE
3/16" PINION CLEARANCE
REMOVE CONNECTOR FROM "MOTOR TERMINAL" OF SOLENOID

Figure 15—Adjusting pinion clearance on overrunning clutch type cranking motor equipped with solenoid having non-adjustable plunger stud.

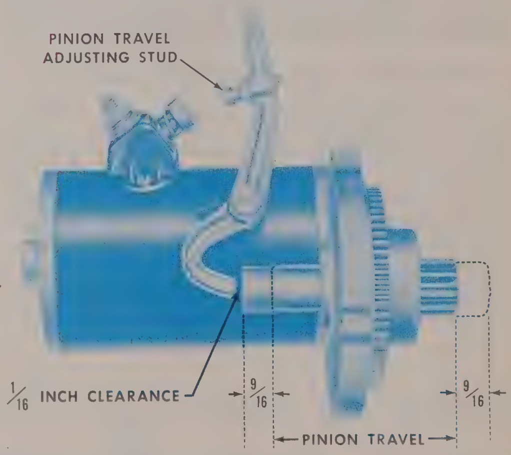

PINION TRAVEL ADJUSTING STUD
1/16 INCH CLEARANCE
9/16
9/16
PINION TRAVEL

Figure 16—Aircraft type overrunning clutch cranking motor showing measurement of pinion travel and clearance between overrunning clutch assembly and shift lever.

AIRCRAFT TYPE OVERRUNNING CLUTCH MOTOR

A sectional view of the aircraft type overrunning clutch cranking motor is shown in Bulletin 1M-120. Disassembly of this unit is similar to other cranking motors already discussed.

After this cranking motor has been reinstalled on the airplane it is very important to adjust the linkage to the cranking motor shift lever so that the correct pinion travel will be obtained when the cranking motor control is operated. If the pinion travel is incorrect, insufficient depth of mesh may be obtained with resulting serious damage to the drive pinion or engine flywheel.

To check the pinion travel on the manually operated unit, first make sure that the spring is returning the lever to its fully released position. In this position there should be 1/16 inch clearance be-

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tween the lower end of the shift lever and the button on the back of the overrunning clutch drive. (See Figure 16.) Then operate the shift lever control to see whether 9/16 inch pinion travel is obtained. This movement can be measured on the visible part of the clutch as illustrated in Figure 16. Adjustment can be made by turning the pinion travel adjusting stud in the shift lever.

On solenoid-operated units, remove connector from "motor terminal" of solenoid (to prevent cranking motor from operating), and connect a battery of the specified voltage between the switch terminal on the solenoid and the solenoid base (ground). This will cause the solenoid to shift the pinion into mesh, and the pinion travel can be measured as explained in the previous paragraph. Adjust by detaching the linkage to the solenoid plunger stud and turning the stud in or out as required.

DYER DRIVE TYPE CRANKING MOTOR

Figure 17 illustrates an exploded view of a heavy-duty Delco-Remy Dyer drive cranking motor. This type of cranking motor is supplied with or without a solenoid assembly. Operation of the Dyer drive is discussed in Bulletin 1M-130, and of the solenoid in 1S-120. The series-parallel 12-24 volt system with which this cranking motor is often used is discussed in Bulletin 1S-130.

To disassemble this type cranking motor, first separate the unit into its main subassemblies. Take off the cranking motor manual switch or solenoid switch (whichever is used), detach drive housing assembly by bending up the tangs on lock washer so screws can be removed. Discard lock washers since it is not safe to use this type of lock washer more than once inasmuch as repeated bending of the tangs will break them off. Remove armature with intermediate bearing and Dyer drive assembly from the drive-end-frame assembly by unscrewing the bearing attaching screws. With some types of construction the drive housing attaching screws also hold the intermediate bearing in place.

Separate commutator end frame from field frame by removing cover band, detaching brush leads from field leads and unscrewing end-frame attaching screws (discarding tang lock washers).

The brush plate assembly may be removed from the commutator end frame by unscrewing nuts from the terminal and taking out the screws holding the brush plate in place. The brush plate assembly may be disassembled by unscrewing the brush spring posts and brush holder attaching screws. Figure 18 is an exploded view of a typical brush plate assembly and it may be used as a guide in disassembly and reassembly. On reassembly, pay particular attention to the insulators which insulate insulated brush holders from the brush plate.

Removal of the field coils from the field frame has already been covered (page 6).

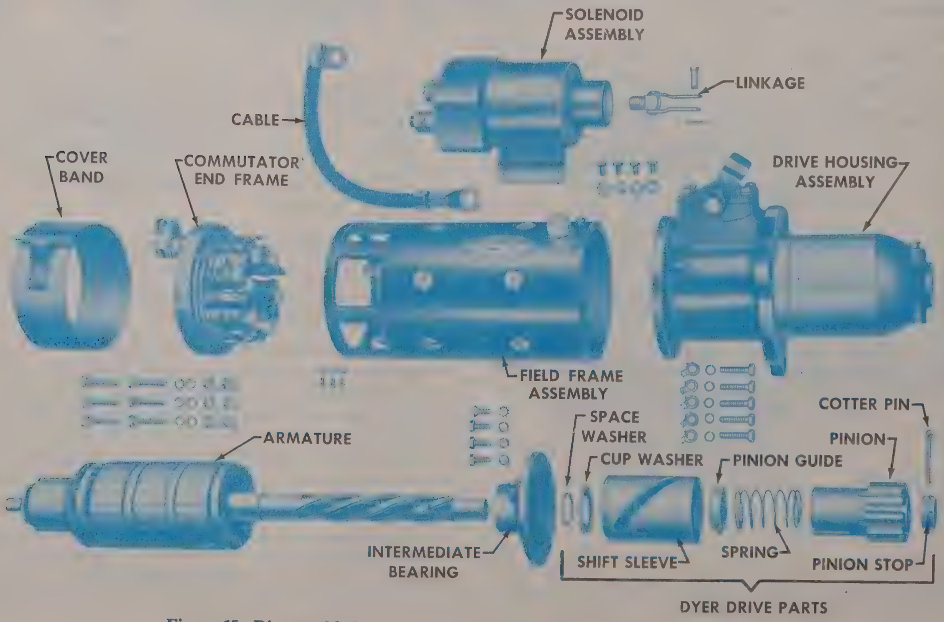

Figure 17—Disassembled view of a heavy-duty Dyer drive cranking motor.

The Dyer drive is disassembled from the armature shaft by pulling out the cotter pin and removing the pinion stop, pinion, spring, pinion guide, shift sleeve and two washers. The intermediate bearing may be removed from the armature shaft. After the cotter pin has been removed, the pinion stop must be rotated until the notches register with the shaft splines. The remainder of the assemblies will slip off easily if pressure is applied against the shift sleeve. Armature service is outlined on page 12.

A special procedure is required to reassemble the Dyer drive assembly on to the armature shaft. As a first step, put the intermediate bearing on the armature shaft. Some applications use a collar which is put on the armature shaft before the bearing. Then install the plain washer and cupped thrust washer with the cupped section facing the shift sleeve. Assemble the shift sleeve, pinion guide and spring on the armature shaft as shown in Figure 19. Note that the lugs on the pinion guide are toward the pinion. Do not twist the pinion guide on to the spline shaft more than about 1¾ inches from the end of the shaft. Hold the guide in this position and put the pinion on the shaft over the spring, compressing the spring into the pinion skirt. (See Figure 20.) Align the lugs on the pinion guide with the slots which are cut in the skirt of the piston. With the thumb and forefinger (as shown in Figure 20) hold the pinion guide stationary while pushing the pinion on to the shaft so the lugs enter the slots in the piston skirts. Then remove the thumb and forefinger and twist the assembly back on to the armature shaft and into the shift sleeve. As it reaches the extreme position, a click will be heard which indicates that the pinion guide has dropped into the undercut section of the shaft splines so that the assembly is locked in the demeshed position.

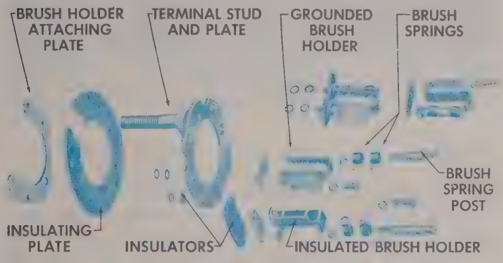

Figure 18—Disassembled view of brush plate of type used in cranking motor shown in Figure 17.

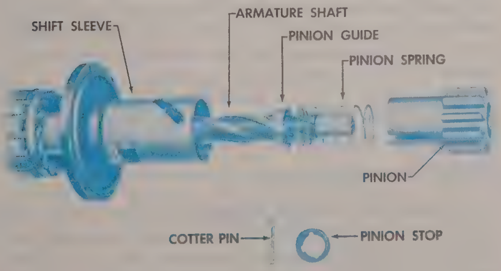

Figure 19—Dyer drive assembly shown in partly disassembled view.

Replace the pinion stop by aligning it with the spline grooves and turning it on until it hits the undercut. It can then be rotated to align the holes in the shaft and pinion stop. This permits replacement of the cotter pin so that the pinion stop will be held in position.

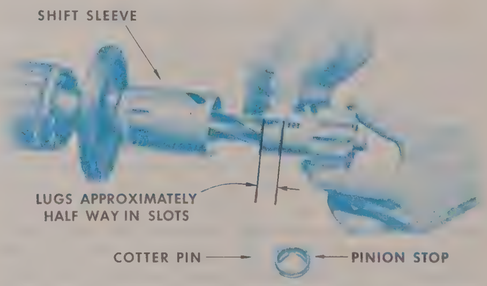

Figure 20—Procedure of reassembling pinion, pinion guide, and spring in Dyer drive assembly.

Lubricate the drive after reassembly with a small amount of light engine oil. Do not use heavy oil or grease as this might retard or prevent normal drive action.

When the shift lever is in the cranking position it should be possible to push the pinion back against spring pressure ⅛ to 3/16 inch as shown in Figure 21. This adjustment can be checked on the manually operated cranking motor by operating the shift lever until the manual switch is closed (battery disconnected) and then measuring the distance the pinion can be pushed back. Adjustment can be made by turning the adjusting stud in the shift lever. On the solenoid operated cranking motor, disconnect the lead between the solenoid and cranking motor and connect a battery of the specified voltage to the two small solenoid terminals (or to the small terminal and the solenoid base if there is but one small terminal). If the plunger does not pull in, move it in by hand. Battery current will then maintain it in the operating position so that the pinion travel can be checked. Adjustment is made by turning the stud in the plunger in or out as required.

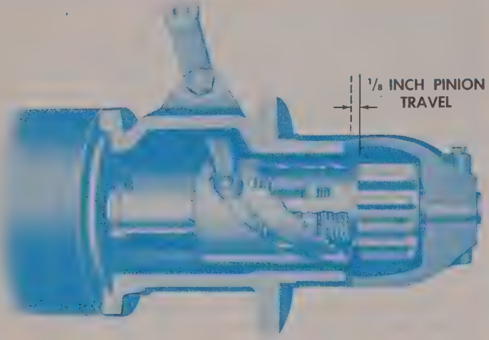

Figure 21—Pinion travel check in Dyer drive assembly.

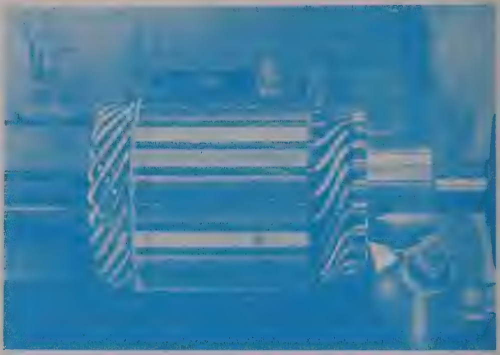

Figure 22—Armature set up in lathe so commutator can be turned.

INSPECTION AND REPAIR OF PARTS

The armature and field coils should not be cleaned in any degreasing tank or by use of degreasing compounds since this might damage insulation so that a short circuit or ground would consequently develop. Sealed ball bearings should not be cleaned inasmuch as this would remove the lubricant originally packed in the bearings. Other cranking motor parts should be cleaned and inspected for wear or other damage. Bulletin 1S-120 discusses maintenance of magnetic switches and solenoids. On reassembly all soldered electrical connections should be made with rosin flux. Never use acid flux on electrical connections.

ARMATURE SERVICING

The armature should be checked for opens, short circuits, or grounds as explained in the following paragraphs. If the armature commutator is worn, dirty, out of round or has high mica, the armature should be put in a lathe (Fig. 22) so the commutator can be turned down. The mica should then be undercut 1/32 of an inch and the slots cleaned out to remove any trace of dirt or copper dust. As a final step in this procedure the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

Open circuited armatures can often be saved where the open is obvious and repairable. The most likely place for an open to occur is at the commutator riser bars as a result of excessively long cranking periods. Long cranking periods overheat the cranking motor so that the solder in the connections melts and is thrown out. The consequent poor connections then cause arcing and burning of the commutator bars as the cranking motor is used. If the bars are not too badly burned repair can often be effected by resoldering the leads in the riser bars (using rosin flux) and turning down the commutator in a lathe (Fig. 22) to remove the burned material. The mica should then be undercut. Some cranking motor armatures are of the welded construction with the armature coil leads welded and not soldered to the commutator bars. This type of armature should not be repaired by ordinary soldering methods.

Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler with a steel strip such as a hack-saw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Copper or brush dust in the slots between the commutator bars sometimes produces shorts between bars which can be eliminated by cleaning out the slots.

Grounds in the armature can be detected by the use of a test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure which is often brought about by overheating of the cranking motor produced by excessively long cranking periods or by accumulation of brush dust between the commutator bars and the steel commutator ring.

FIELD COIL SERVICE

The removal and reinstallation of the field coils is covered on page 6. They can be checked before removal for grounds or opens as outlined on pages 4 and 5.

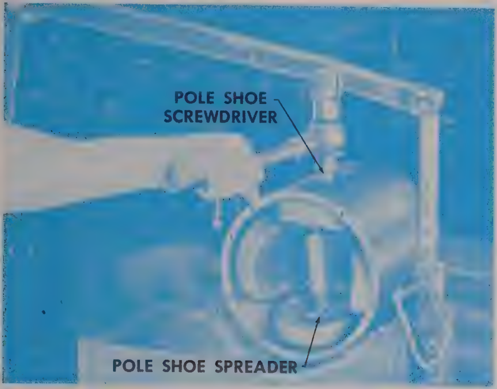

Figure 23—Using pole shoe screw driver and spreader.

Grounded field coils may sometimes be repaired by removing and reinsulating them. Care must be used in applying new insulation to avoid excessive bulkiness since this might cause the pole shoe to cut through and produce another ground when the coils are reinstalled.

On reinstallation note particularly the location of insulating strips (where used) as explained on page 6.

USE OF INSULATING VARNISH

On installation where excessive moisture conditions are experienced, it may be desirable to treat the field coils as well as the armature windings with one of the insulating varnishes supplied for this purpose. This will provide protection against excessive moisture in the coils or windings.

OVERRUNNING CLUTCH CHECK

Never clean the overrunning clutch by any degreasing or high temperature method since this will remove the lubricant originally packed in the clutch so that the clutch would soon be ruined. Wipe the clutch with a clean cloth. The drive pinion must rotate freely in the overrunning direction and must not slip in the cranking direction. If the pinion turns roughly or slips in the cranking direction, replace the overrunning clutch assembly.

WIRING INSTALLATION

In installing the wiring between the cranking motor and battery every precaution should be taken to guard against the possibility of short circuit or ground. All wires should be of sufficient size to carry the electrical load without excessive voltage drop. Stranded wire and cable should be used to guard against breakage due to vibration.

All joints and connections should be clean and tight. Terminal clips should be soldered to leads with rosin flux. Acid flux must never be used on electrical connections.

All leads and cables should be supported at enough points to prevent them from moving about so that the insulation will become worn through. On 12 and 24 volt systems extra precaution should be taken to avoid shorts or grounds. On these higher voltage systems, it would be well to insulate all terminals and clips normally left exposed. This can be done with rubber boots, rubber tape or friction tape and shellac. Insulating terminals and clips in this manner will guard against accidental shorting or grounding. Fuses of the proper capacity should be used in accessory or lighting circuits wherever indicated and should be of the proper capacity to give ample protection in case a short or ground develops in a fused circuit.

WIRE SIZES

Good cranking performance will not be obtained if the cables between the battery and cranking motor are of inadequate size. This is particularly true on heavy-duty applications such as busses and trucks. With inadequate cables or bad connections, excessive voltage drop between the battery and cranking motor will be obtained with consequent poor cranking performance.

The table below lists the maximum allowable length of the four sizes of cable commonly used for 6 and 12, and for 24 volt systems. The length includes the distance from the battery to ground, battery to cranking motor switch and switch to cranking motor. Cable length should not exceed the figures given below. For extra long circuits it may be necessary to use two parallel cables. For example, two No. 0 cables would be satisfactory for a 20 foot circuit in a 6 or 12 volt system.

Cable Size (B & S. Gauge)	Feet 6 & 12 volt circuit	Feet 24 volt circuit
0	10	20
00	12	24
000	16	32
0000	20	40

LENGTH OF STARTING CYCLE

If the engine fails to start after extended cranking, check for cause and do not continue to crank since this will not only run the batteries down but will also overheat and damage the cranking motor.

> CAUTION: Never operate the cranking motor for more than 30 seconds at a time without pausing for several minutes to permit the cranking motor to cool off.

DELCO-REMY
SERVICE BULLETIN

BULLETIN **1D-150**
Date 7-21-50
9 Pages Page 1
File Under:
D-IGNITION
DISTRIBUTORS

Supersedes Bulletin
1D-150, Dated 3-8-49

ADJUSTMENTS, TESTS AND MAINTENANCE OF IGNITION DISTRIBUTORS

The best assurance of obtaining maximum service with minimum trouble from ignition systems in general and ignition distributors in particular is to follow a regular inspection and maintenance procedure. Periodic lubrication where required, inspection of the distributor contact points, centrifugal and vacuum advance mechanisms, connections and cables, distributor cap and rotor are essentials in the inspection procedure. In addition, the distributor may be placed in a distributor tester at periodic intervals so the action of the advance mechanisms can be checked. The ignition coil and condenser should be checked periodically on testers specifically designed for the purpose. As a final step, the contact point opening or cam angle should be checked and adjusted, and the distributor reinstalled on the engine and timed.

IGNITION DISTRIBUTOR MAINTENANCE

LUBRICATION

The distributor requires lubrication of the shaft advance mechanism, breaker cam, breaker plate assembly (rotating types), and breaker lever pivot. The shaft is lubricated by a variety of methods, and lubrication recommendations are as follows: Hinge cap oilers should have 8 to 10 drops of light engine oil (10 W) every 5,000 miles. Grease cups should be turned down one turn every 5,000 miles and refilled with No. 2½ grease as required. High pressure grease fittings, on distributors so equipped, should be supplied with grease every 5,000 miles. Continue to force lubricant into grease fittings until it comes out relief hole in a steady stream. Use Delco-Remy Cam and Ball Bearing Lubricant on distributors equipped with ball bearings and No. 2½ grease on others. Repack sealed tachometer or governor drive gear chambers with No. 2½ grease every 25,000 miles. Gear chambers equipped with grease cups require the addition of one full cup of No. 2½ grease every 5,000 miles.

Distributors with built-in lubrication (Fig. 18 and Fig. 19) are assembled with a supply of oil in the reservoir. Under normal operating conditions, the reservoir should be refilled every 10,000 miles or 200 hours of operation. (More frequent refilling is required when unusual heat or other operating conditions are experienced.) To refill reservoir remove the oil plug and add Grade 20 W oil. When replacing plug, seal with a compound that will hold against oil.

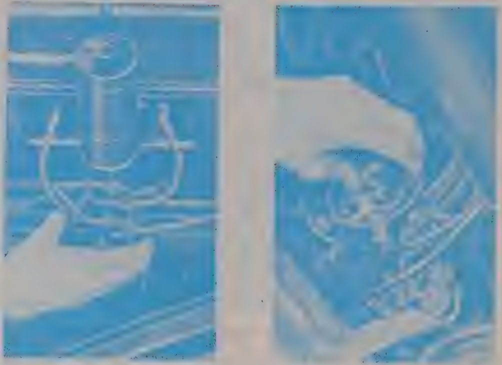

Figure 1—Testing vacuum advance mechanism.

A trace of Delco-Remy Cam and Ball Bearing Lubricant should be placed on the breaker cam every 5,000 miles, except on distributors having cam lubricators (see Bulletin 1D-115). On these, grease the cam every 10,000 miles. Install new cam lubricator if felt appears worn. Every 5,000 miles put 1 to 2 drops of light engine oil (10 W) on the breaker lever pivot and 3 to 4 drops on the felt wick under the rotor. On ball-supported breaker plates, place a small amount of Delco-Remy Cam and Ball Bearing Lubricant on each ball every 5,000 miles; on center-bearing breaker plates, add 3 to 4 drops of light engine oil (10 W) to the felt wick between the plates every 5,000 miles.

Avoid excessive lubrication. If too much oil is used, the excess is apt to get on the contact points and cause them to burn.

INSPECTION

At periodic intervals the components of the ignition system should be inspected and serviced as explained in the following paragraphs.

As a first step in the inspection procedure, check the condition of the battery and battery cable (Bulletin 7D-100). Then check the vacuum advance mechanism to make sure it operates freely. On the type which rotates the complete distributor, turn the distributor in its mounting by hand (Fig. 1) and then release it. The vacuum advance spring should return it to its original position without sticking. On the type which rotates the

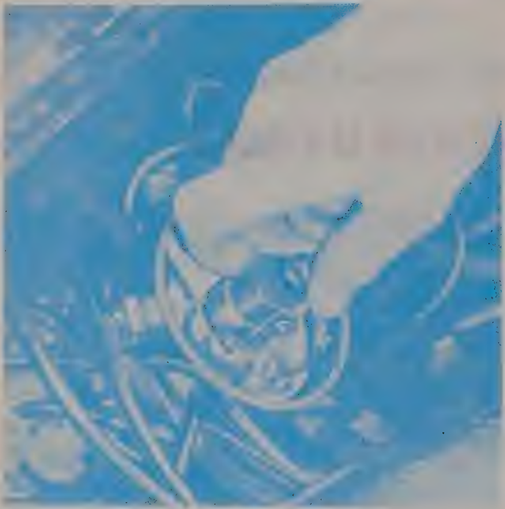

Figure 2—Testing centrifugal advance mechanism.

Figure 3—Wiping distributor cap with clean cloth.

breaker plate only, turn the plate by hand (Fig.1). The breaker plate should return to its original position when released.

CENTRIFUGAL ADVANCE MECHANISM

The centrifugal advance mechanism can also be checked for freeness by turning the breaker cam in the direction of rotation (Fig. 2) and then releasing it. The advance springs should return the cam to its original position without sticking.

These checks provide information on the condition of the advance mechanisms, but do not, of course, supply data on the manner in which they actually operate. To obtain that data, the distributor must be removed from the engine and checked on a distributor tester. If the mechanisms do not function normally, the distributor will require servicing.

CAP

Wipe out the distributor cap with a clean cloth and inspect it and the rotor for chips, cracks and carbonized paths which would allow high-tension leakage to ground. Such defects require replacement of the part.

CONTACT POINTS

The point opening of new points can be checked with a feeler gauge, but the use of a feeler gauge on older, rough points is not recommended since accurate gauging cannot be done on such points (Fig. 4). The gauge measures between high spots on the points instead of the true point opening. Point opening of used points can be checked with a dial indicator (Fig. 5). To adjust the point opening, loosen the lock screw and turn the eccentric (Fig.7). Tighten the lock screw well after adjustment is complete.

A cam angle meter can be used to check the cam or contact angle. This angle is the number of degrees that the breaker cam rotates from the time

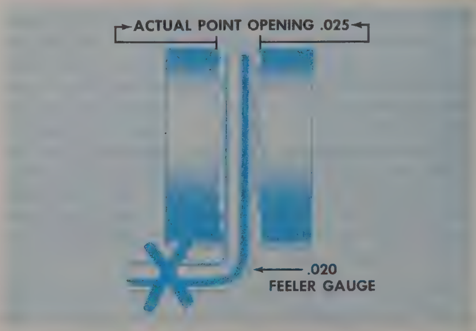

Figure 4—Reason why feeler gauge cannot be used on rough contact points. Note that gauge measures the distance from high spot to high spot on points and not the actual opening.

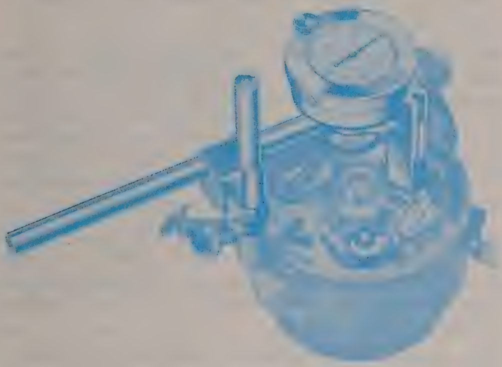

Figure 5—Using dial indicator to check contact point opening.

the points close until they open again (Fig. 6). The cam angle increases as the point opening is decreased and it is reduced as the point opening is increased.

The contact point pressure should be checked with a spring gauge (Fig. 8). The scale should be hooked to the breaker lever and the pull exerted at an angle of 90° with the point surface. Reading should be taken just as points separate. The pressure can be adjusted by bending the breaker lever spring. If the pressure is excessive, it can be decreased by pinching the spring carefully. To increase, the lever must be removed from the distributor so the spring can be bent away from the lever. Avoid excessive spring distortion. New breaker lever springs may be stronger than required in service; be sure to check the spring tension of all new levers when installed. Remember that excessive pressure causes rapid rubbing block, cam, and contact point wear while insufficient pressure will permit high-speed point bounce which will, in turn, cause arcing and burning of the points and missing of the engine.

CLEANING CONTACT POINTS

Clean the points, if necessary, with a few strokes of a clean, fine-cut contact file. Do not attempt to remove all roughness nor dress the point surfaces down smooth; merely remove scale or dirt. Never use emery cloth or sandpaper to clean points since particles will embed and cause arcing and rapid burning of the points.

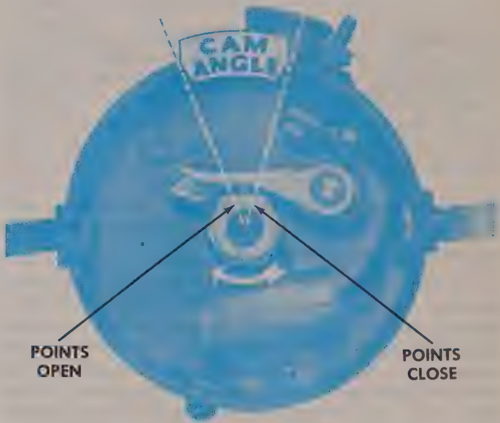

Figure 6—Cam angle is the number of degrees of breaker cam rotation from time points close until they open again.

ABNORMAL CONTACT POINT WEAR

Under normal operating conditions, distributor contact points will provide many thousands of miles of service. Points which have undergone several thousand miles of operation will have a rough surface, but this should not be interpreted as meaning that the points are worn out. The roughness between the points matches so that a

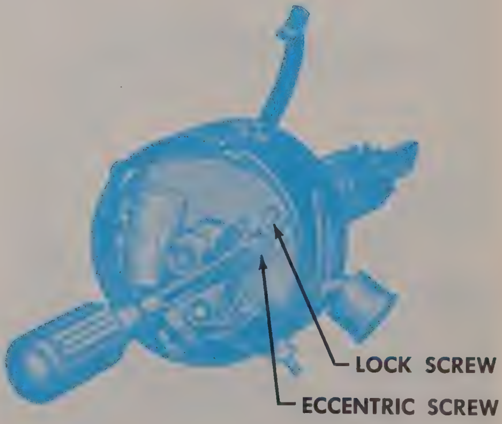

Figure 7—Adjust point opening by loosening lock screw and turning eccentric screw.

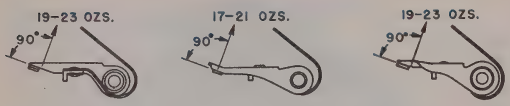

Figure 8—Spring tensions for three types of breaker levers.

large contact area is maintained; the points will continue to provide satisfactory service until most of the tungsten is worn off.

However, if the points burn or pit, they will soon become unsatisfactory for further operation. Not only must they be replaced, but the ignition system and engine must be checked to determine the cause of the trouble so it can be eliminated. Unless the condition causing the point burning or pitting is corrected, the new points will provide no better service than the old points.

BURNING OF POINTS

Contact point burning will result from high voltage, presence of oil or other foreign material, defective condenser and improper point adjustment. High voltage causes an excessively high current flow through the contact points which burns them rapidly. High voltage can result from an improperly adjusted or inoperative voltage regulator or from an excessively advanced third brush adjustment on third brush generators without a regulator.

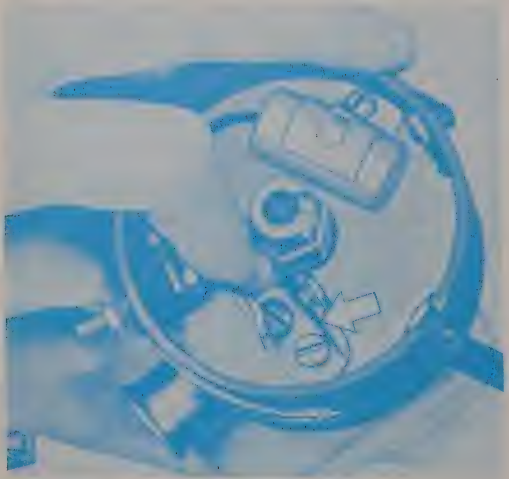

Figure 9—A smudgy line under the contact points indicates that oil or crankcase vapor is getting between the points, causing rapid burning of the points.

Oil or crankcase vapors which work up into the distributor and deposit on the point surfaces will cause them to burn rapidly. This is easy to detect since the oil produces a smudgy line under the contact points (Fig. 9). Clogged engine breather pipes permit crankcase pressure which will force oil or vapors up into the distributor. Overoiling the distributor will also produce the condition.

If the contact point opening is too small (cam angle too large), the points will be closed too large a part of the total operating time. Average current flow through the points will be too high so the points will burn rapidly.

High series resistance in the condenser circuit will prevent normal condenser action so the contact points will burn rapidly. This resistance may be caused by a loose condenser mounting or lead connection, or by poor connections inside the condenser.

A special condenser tester is required to detect excessive resistance. Other checks to which the condenser should be submitted include breakdown, low-insulation resistance, and capacity.

PITTING OF POINTS

Contact point pitting results from an out-of-balance condition in the ignition system which causes transfer of tungsten from one to the other point so that a tip builds up on one point while a pit forms in the other (Figs. 10 and 11). The direction in which the tungsten transfers can be used as a basis for analysis and correction of pitting. For instance, if the material transfers from the negative to the positive point (Fig. 10), one or more of

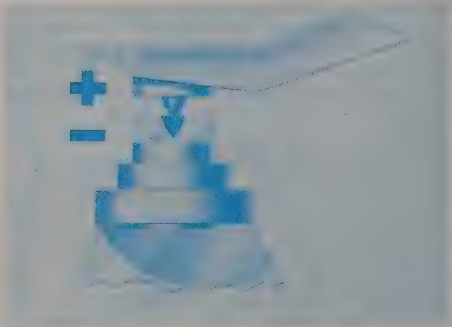

Figure 10—Point pitting in which tungsten transfers from the negative to the positive point.

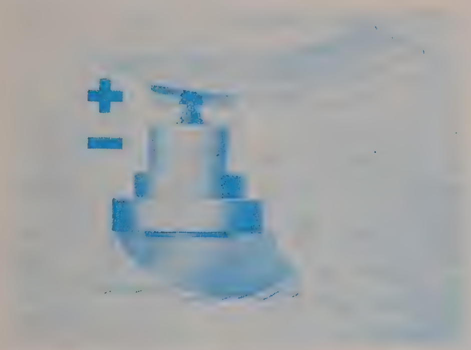

Figure 11—Point pitting in which tungsten transfers from the positive to the negative point.

these corrections may be made: increase condenser capacity; shorten condenser lead; separate distributor-to-coil low- and high-tension leads; move these leads closer to ground (engine block, frame, panel); remount coil directly to ground where coil depends on a lead for grounding.

If the material transfers from the positive to the negative point (Fig. 11), reduce condenser capacity, move distributor-to-coil leads closer together, move these leads away from ground, or lengthen condenser lead.

CABLES

The low- and high-tension cables should be examined carefully for brittle or cracked insulation and broken strands. Defective insulation will permit missing or cross firing of the engine. Connections should be clean and tight.

SPARK PLUGS

Spark plugs should be removed and checked for cracked porcelain and for wear. They should be cleaned and regapped or replaced as necessary. When readjusting the spark gap, bend the outer electrode only. Never bend the center electrode as this may cause the porcelain to crack. Refer to the plug manufacturer's service instructions for details of spark plug service.

TIMING AND SYNCHRONIZATION

Set advance adjustment arm or selector to zero and tighten arm hold-down bolt before attempting to time the distributor to the engine. Motor vehicles have flywheel markings to facilitate timing. Refer to the engine manufacturer's service instructions for details of timing. All ignition distributors with manually controlled spark should be timed in the full manual advanced position to eliminate variations in the manual control linkage. Some distributors having vacuum controlled spark have a ⅛ inch hole in the advance arm and clamp arm. On these units it is necessary to align the holes with a ⅛ inch pin before timing. To correct timing, loosen the distributor clamp bolt or bolts and rotate the distributor in its mounting. Tighten bolt or bolts after timing is completed.

On some engines it is not possible to synchronize double breaker lever distributors on the engine without special synchronizing tools. This is particularly true on twelve and sixteen cylinder engines.

DISASSEMBLY

The disassembly procedure varies somewhat according to the type of distributor, but normally little difficulty will be experienced. In the type unit shown in Figure 12, disassemble by unsnapping cap springs, taking off cap, rotor and dust seal. Then disassemble terminal, take off breaker plate attaching screws, and lift out breaker plate. Remove coupling or gear by grinding or filing off the peened-over head of pin and then driving out pin. Shaft and advance mechanism can then be lifted out. Advance mechanism is disassembled by taking off nuts fastening hold-down plate in place.

NOTE: When disassembling a distributor with a flexible drive gear, discard old driving blocks, cushions, retainers and pin. These parts, if used a second time, will probably provide too loose a fit for proper vibration-absorbing action.

The distributor illustrated in Figure 13 is similar to that shown in Figure 12 except that it embodies an accessory drive to drive an engine governor or tachometer. Disassembly is similar for the two units except that, in the distributor shown in Figure 13, the bearing must be unscrewed and the accessory

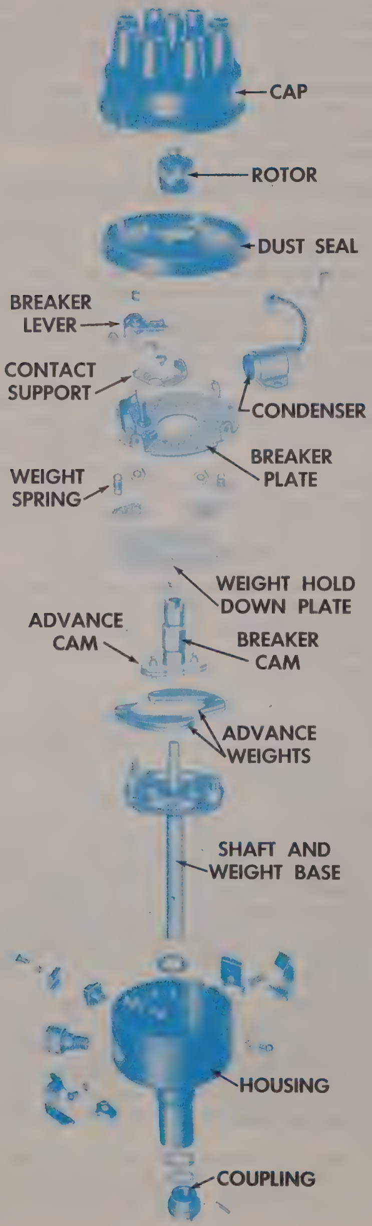
CAP
ROTOR
DUST SEAL
BREAKER LEVER
CONTACT SUPPORT
CONDENSER
BREAKER PLATE
WEIGHT SPRING
WEIGHT HOLD DOWN PLATE
ADVANCE CAM
BREAKER CAM
ADVANCE WEIGHTS
SHAFT AND WEIGHT BASE
HOUSING
COUPLING

Figure 12—Exploded view of a typical distributor.

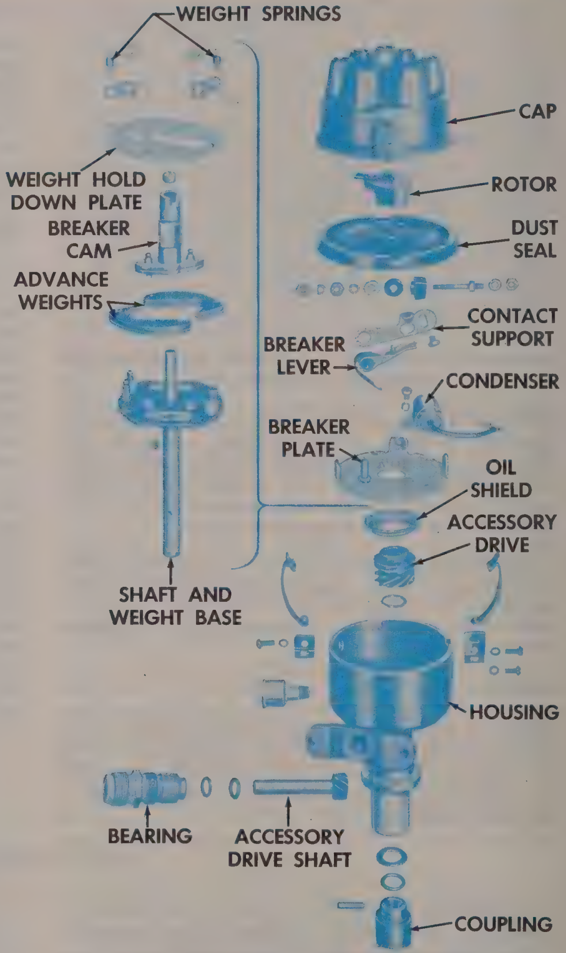
WEIGHT SPRINGS
WEIGHT HOLD DOWN PLATE
BREAKER CAM
ADVANCE WEIGHTS
SHAFT AND WEIGHT BASE
CAP
ROTOR
DUST SEAL
CONTACT SUPPORT
BREAKER LEVER
CONDENSER
BREAKER PLATE
OIL SHIELD
ACCESSORY DRIVE
HOUSING
BEARING
ACCESSORY DRIVE SHAFT
COUPLING

Figure 13—Exploded view of a distributor which has arrangement to drive an engine governor or tachometer.

drive shaft taken out of the housing before the shaft and advance mechanism assembly can be removed.

The distributor illustrated in Figure 14 is of a special construction, incorporating a two-part housing and ball bearings. To disassemble, remove cap and rotor, take out cam locking screw and lift off breaker cam. Remove washers above ball bearing, disconnect lead from primary terminal or disassemble terminal, take out upper housing retainer screws and lift off upper housing. Remove the coupling or gear by pressing out the pin.

The lower bearing races are locked by nuts, and these nuts must be unscrewed from the shaft and

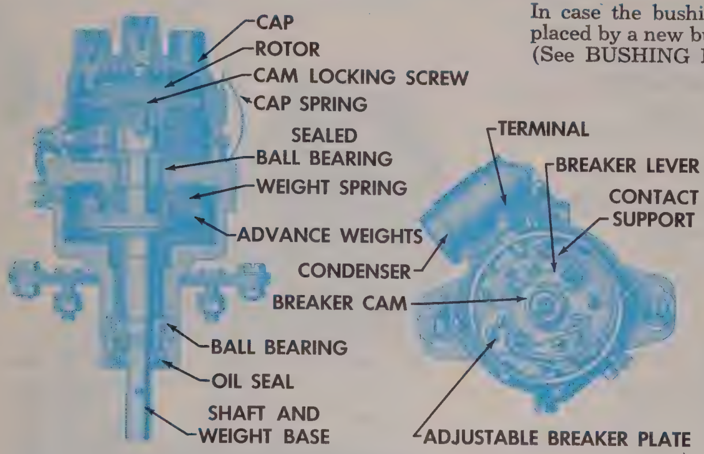
CAP
ROTOR
CAM LOCKING SCREW
CAP SPRING
SEALED BALL BEARING
WEIGHT SPRING
ADVANCE WEIGHTS
CONDENSER
BREAKER CAM
BALL BEARING
OIL SEAL
SHAFT AND WEIGHT BASE
TERMINAL
BREAKER LEVER
CONTACT SUPPORT
ADJUSTABLE BREAKER PLATE

Figure 14—Sectional view of a heavy-duty, double contact point ignition distributor with a two-piece housing.

housing before the lower bearing can be taken out. The shaft can be removed without taking out the bearing by unscrewing the nut that locks the inner race of the bearing to the shaft.

Figure 15 illustrates a special type of heavy-duty distributor for use on a twelve-cylinder engine. It will be noted, however, that the construction of this unit is quite similar to that of the distributor shown in Figure 12. Thus, the disassembly procedure is the same as for that unit. Note, however, that the unit shown in Figure 15 has the special built-in lubrication described in Bulletin 1D-115.

In case the bushing becomes worn, it can be replaced by a new bushing available as a service part. (See BUSHING REPLACEMENT.)

CLEANING, INSPECTION AND TEST OF PARTS

Clean and examine all parts of the distributor after disassembly. Do not clean cap, rotor, condenser, insulators or housing (on units with built-in lubrication) in any degreasing compound since this may damage the part. Examine the centrifugal advance parts, weights, springs and plate, for signs of wear and replace parts that look worn or otherwise damaged. On units with a dust seal, replace the sealing washer if it is hard, worn or dirty. Replace contact points that are worn or pitted, or if the breaker lever rubbing block or bushing is excessively worn. On units with a cam lubricator, replace the lubricator if the lubricating felt wick is worn, hard or dirty.

NEW CENTER-BEARING BREAKER PLATE

Figure 16 illustrates the parts which form the new center-bearing breaker plate assembly as used in the distributors of some late model vehicles. This breaker plate supersedes the type supported on three balls.

To disassemble the center-bearing breaker plate, release the C-shaped stop washer, and remove the

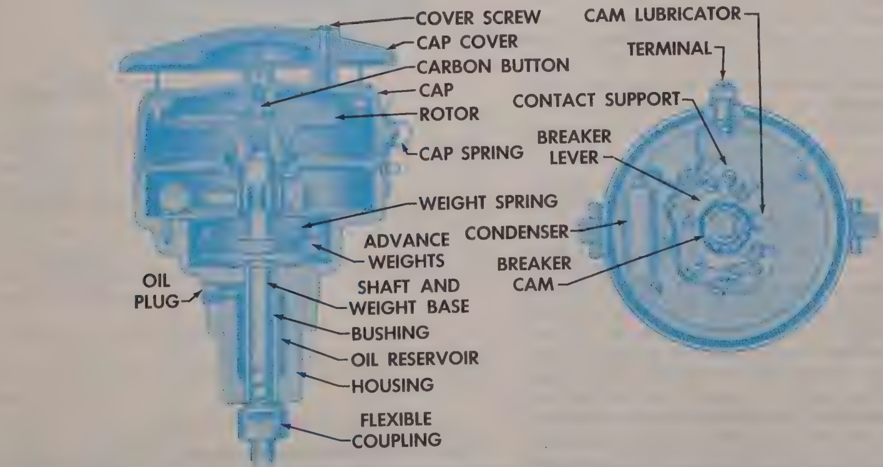
COVER SCREW
CAP COVER
CARBON BUTTON
CAP
ROTOR
CAP SPRING
WEIGHT SPRING
ADVANCE WEIGHTS
OIL PLUG
SHAFT AND WEIGHT BASE
BUSHING
OIL RESERVOIR
HOUSING
FLEXIBLE COUPLING
CAM LUBRICATOR
TERMINAL
CONTACT SUPPORT
BREAKER LEVER
CONDENSER
BREAKER CAM

Figure 15—Sectional view of a heavy-duty, double contact point ignition distributor with built-in lubrication.

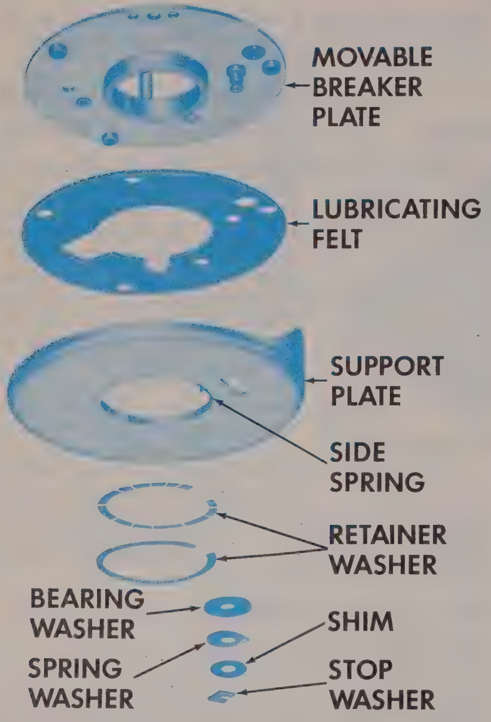

Figure 16—Exploded view of new center-bearing breaker plate assembly.

shim, spring washer, and bearing washer from post. Remove retainer washer (or washers) from center bearing and separate movable plate from support plate. (Take care that the small side spring is not dislodged from its recess in the edge of the center hole in the support plate. This spring helps to prevent any sideplay in the breaker plate assembly and also contributes to the over-all tension of the assembly.) Reassembly is the reverse of disassembly.

The movable breaker plate and support plate are not serviced separately. It is necessary to replace the entire breaker plate assembly if either part becomes seriously damaged or worn. However, the breaker plate will normally require very little service other than lubrication and the occasional adjustment of spring tension. If the breaker plate assembly develops enough looseness to permit tipping and rattling of the movable plate in operation, it will be necessary to increase the spring tension by adding one or more shims to the post carrying the spring washer. Care must be exercised in making this adjustment since the pull required to move the breaker plate must be not less than 8 ounces or more than 16 ounces (Fig. 17) when completely assembled.

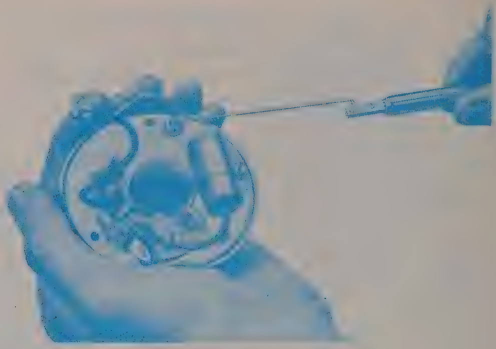

Figure 17—Testing spring tension of center-bearing breaker plate assembly.

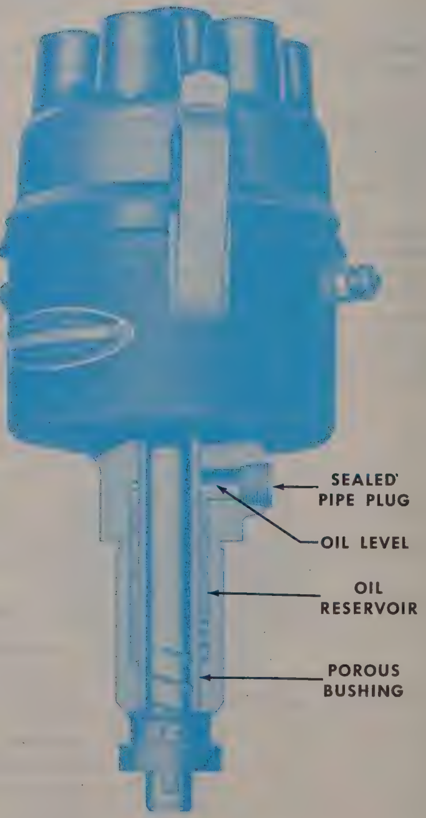

Figure 18—Sectional view of distributor showing details of oil reservoir construction. Shaft is lubricated by seepage of oil through porous bushing. Reservoir should be refilled with Grade 20 W oil. Use of other lubricants will cause bearing failure.

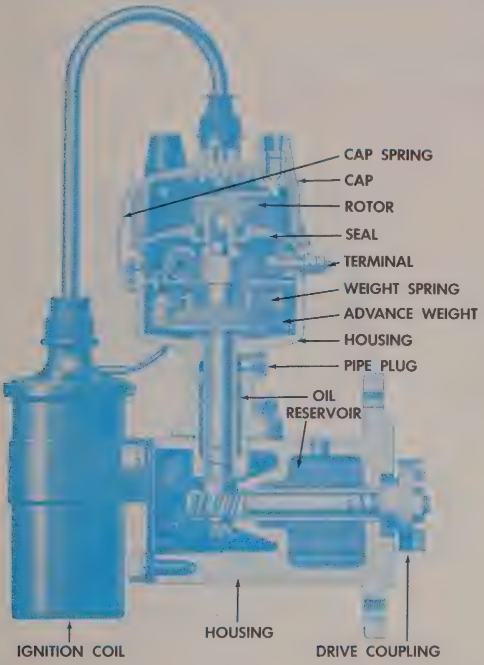

Figure 19—Sectional view of battery ignition unit for farm tractors showing details of construction and lubrication. Distributor shaft and drive shaft are lubricated by seepage of Grade 20 W oil from reservoirs through porous bushings. Gear chamber is packed with No. 2½ grease. Normally additional lubrication will be required only at 500-hour intervals.

The vacuum control linkage must be fitted to the connector bearing on the breaker plate so that there is no upward or downward thrust on the plate when the vacuum control operates, since this will interfere with timing.

BUSHING REPLACEMENT

Bushings or bearings can be replaced on many applications, including units which have built-in lubrication (see Fig. 18 and Fig. 19). Porous bushings are available as service replacement parts, but the actual installation requires great care, as well as the use of a special arbor, in order to prevent damage to the bearing surface. Proper lubrication with a porous bushing depends upon a uniform predictable seepage of oil through the structure of the bushing. The amount of oil which seeps through a porous bushing may be seriously affected by scratches or scuffed areas on the bearing or transmitting surfaces. Porous bushings are manufactured to an exact size and should not be reamed, scraped, or filed. It is very important to use only the grade of oil specified for the oil reservoir since other grades will allow either excessive or inadequate lubrication depending upon viscosity. Under no circumstances must grease be used in the oil reservoir.

REASSEMBLY, TESTING, REINSTALLATION

Reassembly is the reverse of disassembly.

After reassembly the contact point opening or cam angle should be checked and adjusted as already explained (page 2). Breaker lever spring tension should also be checked and adjusted, if necessary (page 3). Then the distributor should be carefully tested on a distributor tester that will check not only the centrifugal advance mechanism, but also the vacuum advance mechanism, where present on the unit.

REINSTALLATION

When installing a distributor, observe the following cautions:

1. Be sure the distributor mounting is clean so there will be a good ground connection for the distributor.
2. Check engine breather pipes, since clogged pipes cause crankcase pressure which will force oil up into the distributor.
3. If the advance mechanism of the old distributor was found to be worn, check the engine for worn timing gears or oil pump, since these cause backlash which produces torsional vibration; such vibration causes rapid advance mechanism wear.
4. Be sure to install the new distributor *all the way down* in its mounting well. If the distributor is not pushed all the way down, the distributor shaft is apt to freeze in the distributor housing and cause complete ruination of the distributor.
5. Be sure that the vacuum line to the distributor, where used, is open.
6. Refer to the section on timing (page 5).

DELCO-REMY
SERVICE BULLETIN

BULLETIN 1R-116
Date 7-26-50
10 Pages Page 1
File Under:
R-RELAYS AND
REGULATORS

Supersedes Bulletin
1R-116, Dated 2-8-49

D-R 1118300 TYPE TWO- AND THREE-UNIT REGULATORS

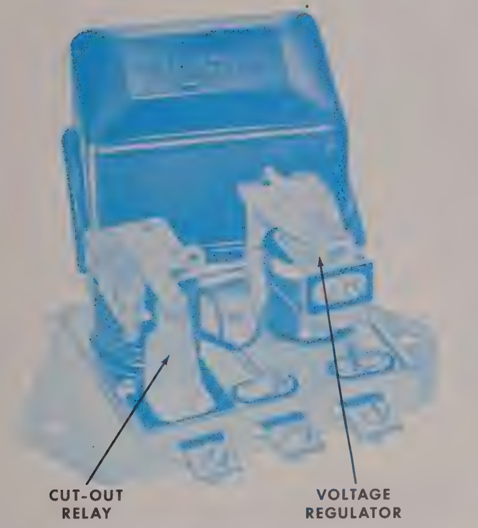

Figure 1—Delco-Remy 1118300 type, two-unit voltage regulator with cover removed so the two units can be seen.

The Delco-Remy two- and three-unit 1118300 series of regulators illustrated in Figures 1 and 2 are designed for use with generators which have the field circuit insulated in the generator but grounded in the regulator. This is in contrast with the Delco-Remy heavy-duty regulators discussed in Bulletins 1R-120, 1R-122 and 1R-133 which are used with generators having their fields grounded internally rather than in the regulator. The two types of regulator are not interchangeable. The 1118300 series of regulators differs essentially from the 1118200 series discussed in Bulletin 1R-115 only in the method of adjustment and in the manner in which the resistances are connected into the field circuit.

TWO-UNIT REGULATOR

The regulator in Figure 1 consists of two units, a cutout relay and a voltage regulator, and is for use with Delco-Remy third-brush generators with externally grounded field circuits. The cutout relay closes the generator-to-battery circuit when the generator voltage is sufficient to charge the battery, and it opens the circuit when the generator slows or stops. The voltage regulator is a voltage limiting device that prevents the voltage from exceeding a specified maximum and reduces generator output to the value required for any particular condition of battery charge and electrical load. Figure 3 is a wiring diagram of this regulator.

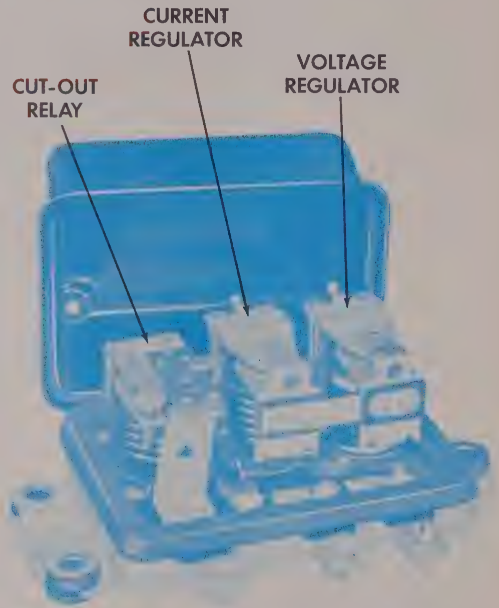

Figure 2—Delco-Remy 1118300 type, three-unit current and voltage regulator with the cover removed so the three units can be seen.

CUTOUT RELAY

The cutout relays on the two-unit and three-unit regulators are of similar construction and have similar wiring circuits (Figs. 3 and 4). The relay has two windings assembled on one core, a series winding of a few turns of heavy wire (shown in solid red) and a shunt winding of many turns of fine wire (shown in dashed red). The shunt winding is shunted across the generator so that generator voltage is impressed upon it at all times. The series winding is connected in series with the charging circuit so that generator output passes through it.

The relay core and windings are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is centered just above the end of the core. The armature has one or two contact points which are located just above

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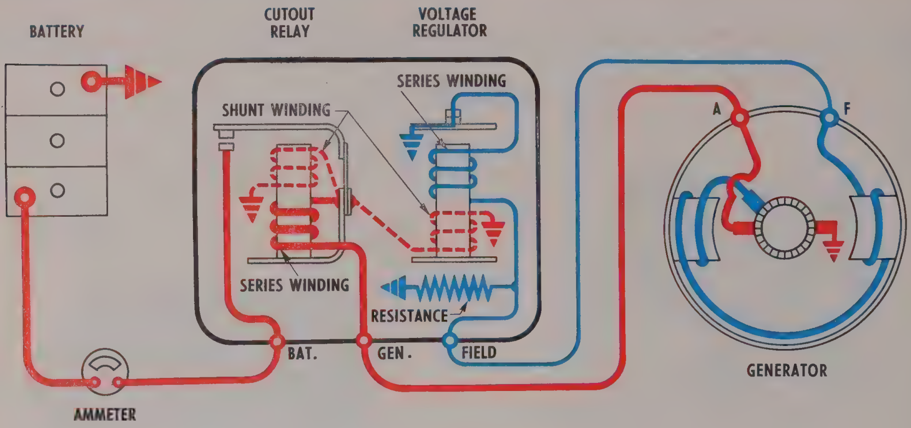


Figure 3—Wiring circuit of Delco-Remy 1118300 type, two-unit regulator shown in Figure 1. The shunt windings in the cutout relay and voltage regulator units are shown in dashed red. The series winding in the cutout relay is shown in solid red. The series winding in the voltage regulator is shown in blue.

a similar number of stationary contact points. When the generator is not operating the armature contact points are held away from the stationary points by the tension of a flat spring riveted on the side of the armature.

CUTOUT RELAY ACTION—When the generator voltage builds up to a value great enough to charge the battery, the magnetism induced in the relay windings is sufficient to overcome the armature spring tension and pull the armature toward the core so that the contact points close. This completes the circuit between the generator and battery. The current which flows from the generator to the battery passes through the series winding in the proper direction to add to the magnetism holding the armature down and the contact points closed.

When the generator slows down or stops, current begins to flow from the battery to the generator. This reverses the direction that the current flows through the series winding, thus causing a reversal of the series winding magnetic field. The magnetic field of the shunt winding does not reverse. Therefore, instead of helping each other, the two windings now magnetically oppose so that the resultant magnetic field becomes insufficient to hold the armature down. The flat spring pulls the armature away from the core so that the points separate; this opens the circuit between the generator and battery.

VOLTAGE REGULATOR

The voltage regulator units in the two-unit and three-unit regulators are of similar construction and have similar wiring circuits (Figs. 3 and 4). The regulator has two windings assembled on a single core, a shunt winding consisting of many turns of fine wire (shown in dashed red) which is shunted across the generator, and a series winding of a few turns of relatively heavy wire (shown in solid blue) which is connected in series with the generator field circuit when the regulator contact points are closed.

The windings and core are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the end of the core. The armature contains a contact point which is just beneath a stationary contact point. When the voltage regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points are in contact and the generator field circuit is completed to ground through them.

VOLTAGE REGULATOR ACTION—When the generator voltage reaches the value for which the voltage regulator is adjusted, the magnetic field produced by the two windings (shunt and series) overcomes the armature spring tension and pulls the armature down so that the contact points separate. This inserts resistance into the generator

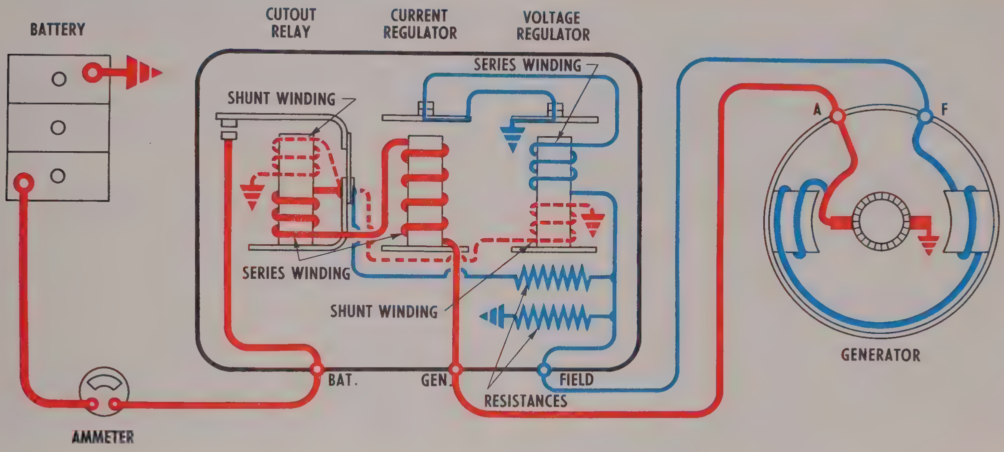


Figure 4—Wiring circuit of Delco-Remy 1118300 type, three-unit regulator shown in Figure 2. The shunt windings in the cutout relay and voltage regulator are shown in dashed red. The series windings in the cutout relay and current regulator are shown in solid red. The series winding in the voltage regulator is shown in blue.

field circuit so that the generator field current and voltage are reduced. Reduction of the generator voltage reduces the magnetic field of the regulator shunt winding. Also, opening the regulator points opens the regulator series winding circuit so that its magnetic field collapses completely. The consequence is that the magnetic field is reduced sufficiently to allow the spiral spring to pull the armature away from the core so that the contact points again close. This directly grounds the generator field circuit so that generator voltage and output increase. The above cycle of action again takes place and the cycle continues at a rate of 150 to 250 times a second, regulating the voltage to a predetermined value. With the voltage thus limited the generator supplies varying amounts of current to meet the varying states of battery charge and electrical load.

THREE-UNIT REGULATOR

The three-unit regulator is designed for use with Delco-Remy shunt type generators with externally grounded field circuits. The regulator contains a cutout relay, a voltage regulator, and a current regulator. The operation of the first two has already been discussed, since they operate in the same manner as the cutout relay and voltage regulator in the two-unit regulator. Operation of the current regulator is discussed here.

CURRENT REGULATOR

The current regulator has a series winding of a few turns of heavy wire (shown in red) which carries all generator output. The winding core is assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the core. The armature has a contact point which is just below a stationary contact point. When the current regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points are in contact. In this position the generator field circuit is completed to ground through the current regulator contact points in series with the voltage regulator contact points.

CURRENT REGULATOR ACTION—When the load demands are heavy, as for example, when electrical devices are turned on and the battery is in a discharged condition, the voltage may not increase to a value sufficient to cause the voltage regulator to operate. Consequently, generator output will continue to increase until the generator reaches rated maximum. This is the current value for which the current regulator is set. Therefore, when the generator reaches rated output, this output, flowing through the current regulator winding, creates sufficient magnetism to pull the current regulator armature down and open the contact points. With the points open, resistance is inserted into the generator field circuit so that the generator output is reduced.

As soon as the generator output starts to fall off, the magnetic field of the current regulator winding is reduced, the spiral spring tension pulls the armature up, the contact points close and directly connect the generator field to ground. Output increases and the above cycle is repeated. The cycle continues to take place while the current regulator is in operation 150 to 250 times a second, preventing the generator from exceeding its rated maximum.

When the electrical load is reduced (electrical devices turned off or battery comes up to charge), then the voltage increases so that the voltage regulator begins to operate and tapers the generator output down. This prevents the current regulator from operating. Either the voltage regulator or the current regulator operates at any one time—the two do not operate at the same time.

RESISTANCES

The current and voltage regulator circuits use a common resistor (Fig. 4) which is inserted in the field circuit when either the current or voltage regulator operates. A second resistor (Fig. 4) is connected between the regulator field terminal and the cutout relay frame, which places it in parallel with the generator field coils. The sudden reduction in field current occurring when either the current or voltage regulator contact points open, is accompanied by a surge of induced voltage in the field coils as the strength of the magnetic field changes. These surges are partially dissipated by the two resistors, thus preventing excessive arcing at the contact points.

NOTE: The resistances in the 1118300 series regulators are connected differently than those in the 1118200 series. See Delco-Remy Service Bulletin 1R-115 for description of 1118200 wiring circuit.

TEMPERATURE COMPENSATION

Voltage regulators are compensated for temperature by means of a bi-metal thermostatic hinge on the armature. This causes the regulator to regulate for a higher voltage when cold which partly compensates for the fact that a higher voltage is required to charge a cold battery. Many current regulators also have a bi-metal thermostatic hinge on the armature. This permits a somewhat higher generator output when the unit is cold but causes the output to drop off as temperature increases.

REGULATOR POLARITY

Some regulators are designed for use with negative grounded batteries while other regulators are designed for use with positive grounded batteries. Using the wrong polarity regulator on an installation will cause the regulator contact points to pit badly and give very short life. As a safeguard against installation of the wrong polarity regulator, all 1118300 type regulators have the model number and the polarity clearly stamped on the end of the regulator base.

REGULATOR MAINTENANCE

GENERAL INSTRUCTIONS

1. Mechanical checks and adjustments (air gaps, point opening) must be made with battery disconnected and regulator preferably off the vehicle.

CAUTION: The cutout relay contact points must never be closed by hand with the battery connected to the regulator. This would cause a high current to flow through the units which would seriously damage them.

2. Electrical checks and adjustments may be made either on or off the vehicle. The regulator must always be operated with the type generator for which it is designed.

3. The regulator must be mounted in the operating position when electrical settings are checked and adjusted and *it must be at operating temperature.*

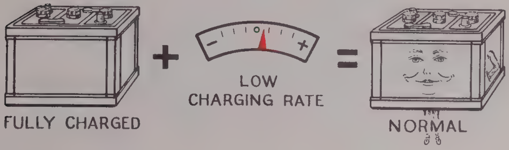
4. After any tests or adjustments the generator on the vehicle must be repolarized after leads are connected *but before the engine is started,* as follows:

REPOLARIZING GENERATOR

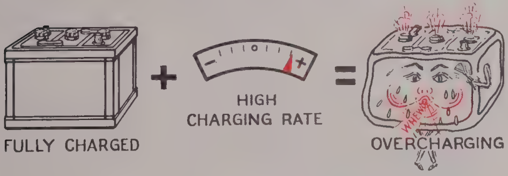
After reconnecting leads, momentarily connect a jumper lead between the "GEN" and "BAT" terminals of the regulator. This allows a momentary surge of current to flow through the generator which correctly polarizes it. Failure to do this may result in severe damage to the equipment since reversed polarity causes vibration, arcing and burning of the relay contact points.

QUICK CHECKS OF GENERATOR AND REGULATOR

In analyzing complaints of generator-regulator operation, any of several basic conditions may be found.



(1) Fully Charged Battery and Low Charging Rate—This indicates normal generator-regulator operation. Regulator settings may be checked as outlined in the following section.



(2) Fully Charged Battery and a High Charging Rate—This indicates that the voltage regulator is not reducing the generator output as it should. A high charging rate to a fully charged battery will damage the battery and the accompanying high voltage is very injurious to all electrical units.

This operating condition may result from:

(a) Improper voltage regulator setting.

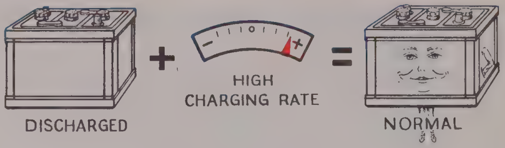
(b) Defective voltage regulator unit.

(c) Grounded generator field circuit (in either generator, regulator or wiring).

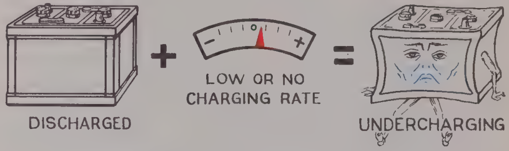
(d) Poor ground connection at regulator.

(e) High temperature which reduces the resistance of the battery to charge so that it will accept a high charging rate even though the voltage regulator setting is normal.

If the trouble is not due to high temperature, determine the cause of trouble by disconnecting the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator (see Service Bulletin 1G-150) or in the wiring harness. If the output drops off the regulator is at fault and it should be checked for a high voltage setting or grounds.



(3) Low Battery and High Charging Rate—This is normal generator-regulator action. Regulator settings may be checked as outlined in the following section.



(4) Low Battery and Low or No Charging Rate—

This condition could be due to:

(a) Loose connections, frayed or damaged wires.

(b) Defective battery.

(c) High circuit resistance.

(d) Low regulator setting.

(e) Oxidized regulator contact points.

(f) Defects within the generator.

If the condition is not caused by loose connections, frayed or damaged wires, proceed as follows to locate cause of trouble.

To determine whether the generator or regulator is at fault, momentarily ground the "F" terminal of the regulator and increase generator speed. If the output does not increase, the generator is probably at fault and it should be checked as outlined in Service Bulletin 1G-150. If the generator output increases, the trouble is due to:

(a) A low voltage (or current) regulator setting.

(b) Oxidized regulator contact points which insert excessive resistance into the generator field circuit so that output remains low.

(c) Generator field circuit open within the regulator at the connections or in the regulator winding.

(5) Burned Resistances, Windings or Contacts—These result from open circuit operation, open resistance units, or high resistance in the charging circuit. Where burned resistances, windings or contacts are found, always check car wiring before installing a new regulator. Otherwise, the new regulator may also fail in the same way.

(6) Burned Relay Contact Points—This may be due to reversed generator polarity. Generator polarity must be corrected as explained on page 4 after any checks of the regulator or generator, or after disconnecting and reconnecting leads.

CLEANING CONTACT POINTS

The contact points of a regulator will not operate indefinitely without some attention. It has been found that a great majority of all regulator trouble can be eliminated by a simple cleaning of the contact points, plus some possible readjustment. The flat points should be cleaned with a spoon or riffler file. On negative grounded regulators which have the flat contact point on the regulator armatures, loosen the contact bracket mounting screws so that the bracket can be tilted to one side (Fig. 5). On positive grounded regulators, the flat point is in the upper contact bracket so the bracket must be removed for cleaning the points. A flat file cannot be used successfully to clean the flat contact points since it will not touch the center of the flat point where point wear is most apt to occur. NEVER USE EMERY CLOTH OR SANDPAPER TO CLEAN THE CONTACT POINTS.

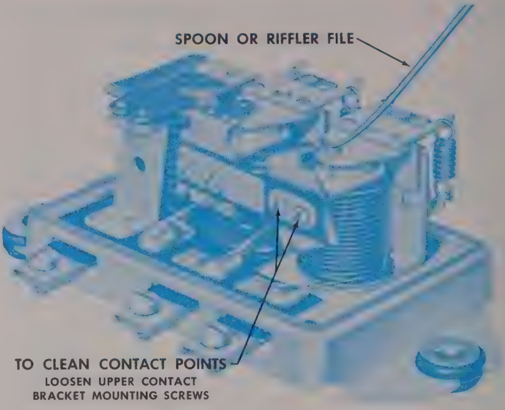

SPOON OR RIFFLER FILE
TO CLEAN CONTACT POINTS
LOOSEN UPPER CONTACT
BRACKET MOUNTING SCREWS

Figure 5—Illustrating use of spoon or riffler file to clean flat contact points in regulator.

TWO-UNIT REGULATOR CHECKS AND ADJUSTMENTS

(See Delco-Remy Service Bulletins 1R-180 and 1R-185 for specifications)

CUTOUT RELAY CHECKS AND ADJUSTMENTS

The cutout relay requires three checks and adjustments: air gap, point opening and closing voltage. The air gap and point opening adjustments must be made with the battery disconnected.

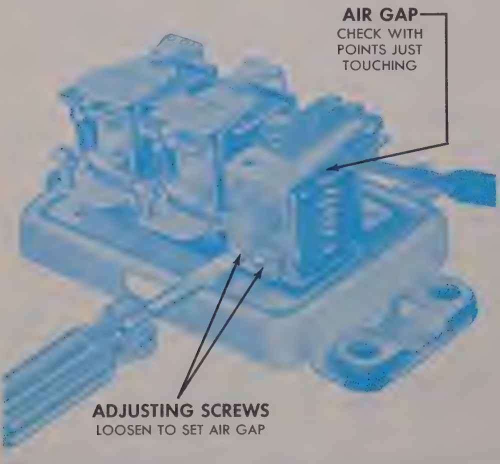

AIR GAP
CHECK WITH
POINTS JUST
TOUCHING
ADJUSTING SCREWS
LOOSEN TO SET AIR GAP

Figure 6—Cutout relay air gap check and adjustment. Battery must be disconnected when this check is made.

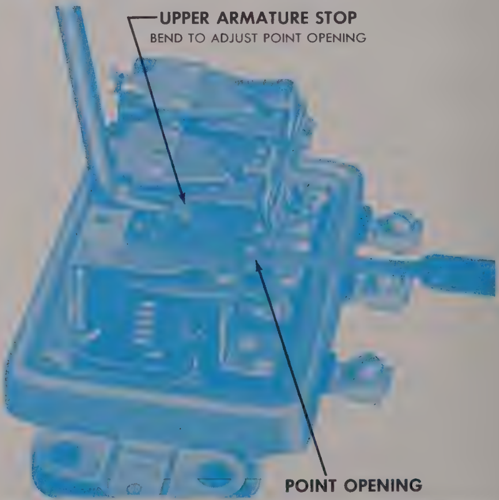

UPPER ARMATURE STOP
BEND TO ADJUST POINT OPENING
POINT OPENING

Figure 7—Cutout relay point opening check and adjustment. Battery must be disconnected when this check is made.

AIR GAP—Place fingers on armature directly above core and move armature down until points just close and then measure air gap between armature and center of core (Fig. 6). On multiple contact point relays, make sure that all points close simultaneously. If they do not, bend spring finger so they do. To adjust air gap, loosen two screws at the back of relay and raise or lower the armature as required. Tighten screws after adjustment.

POINT OPENING—Check point opening and adjust by bending the upper armature stop (Fig. 7).

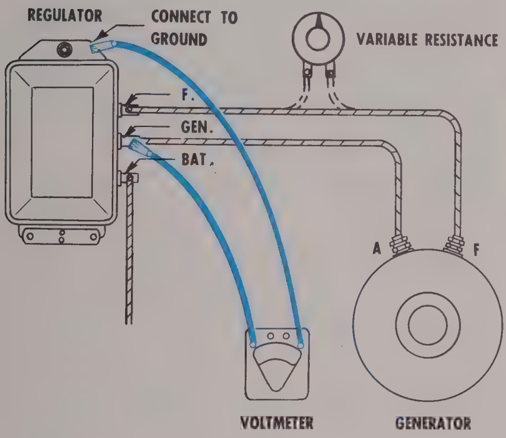


Figure 8—Voltmeter connections to check cutout relay closing voltage. Connections are similar for both two-unit and three-unit 1118300 type regulators.

CLOSING VOLTAGE—To check the closing voltage of the cutout relay, connect the regulator to the proper generator and battery, connect a voltmeter between the regulator "GEN" terminal and regulator base, as shown in Figure 8. Slowly increase the generator speed and note relay closing voltage. Decrease generator speed and make sure that cutout relay contact points open. An alternate method is to use a variable resistor connected in the field circuit as shown in Figure 8. (15 ohm-25 watt for 6 volt, 25 ohm-25 watt for 12 volt). With generator operating at medium speed and resistance all in, slowly decrease the resistance until the cutout relay points close and note the closing voltage. Adjust closing voltage by turning adjusting screw (Fig. 9). Turn screw clockwise to increase spring tension and closing voltage, and turn screw counterclockwise to decrease closing voltage.

VOLTAGE REGULATOR

Two checks and adjustments are required on the voltage regulator, air gap and voltage setting.

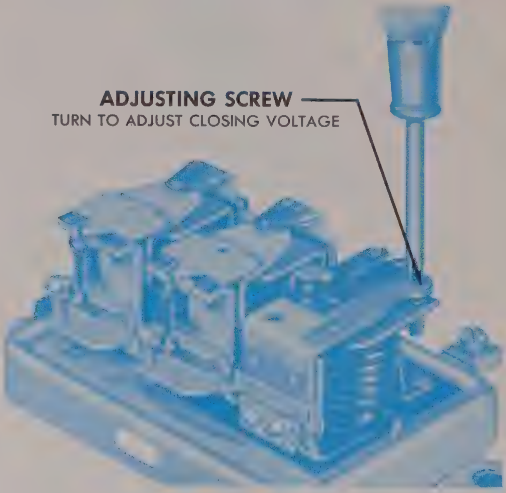


Figure 9—Adjustment of cutout relay closing voltage.

AIR GAP—To check air gap, push armature down until the contact points are just touching and then measure air gap (Fig. 10). Adjust by loosening the contact mounting screws and raising or lowering the contact bracket as required. Be sure the points are lined up, and tighten screws after adjustment.

VOLTAGE SETTING—There are two ways to check the voltage setting—the fixed resistance method and the variable resistance method (Figs. 11 and 12).

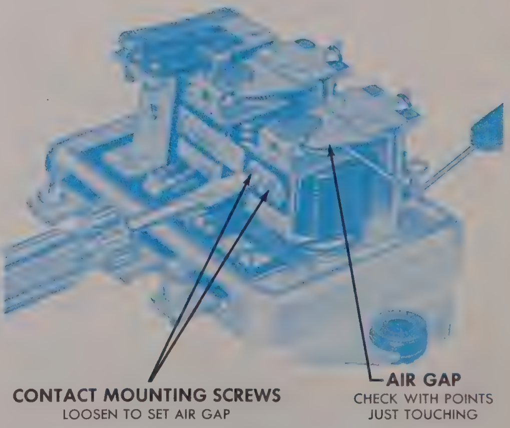


Figure 10—Voltage regulator air gap check and adjustment.

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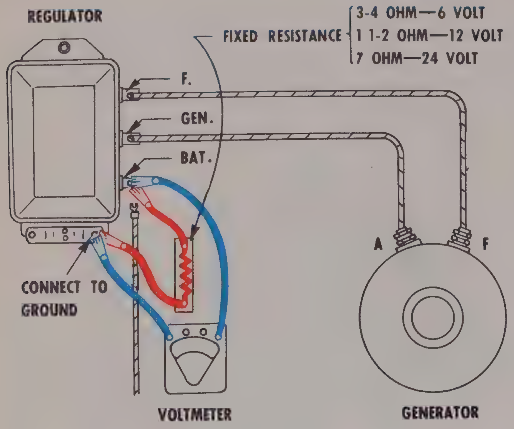

Figure 11—Fixed resistance and voltmeter connections to check voltage regulator setting by fixed resistance method. Fixed resistance leads shown in red and voltmeter leads shown in blue. Connections are similar for both two-unit and three-unit 1118300 type regulator.

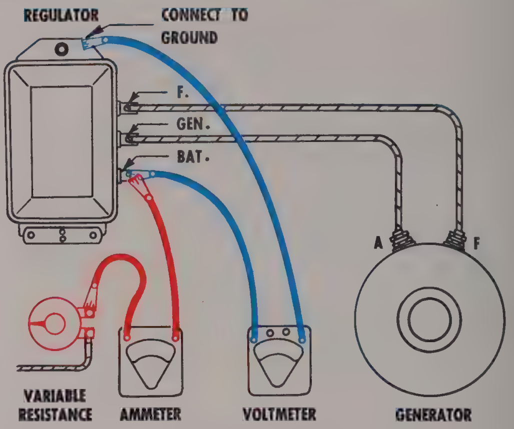

Figure 12—Voltmeter, ammeter and variable resistance connections for checking voltage regulator setting by the variable resistance method. Variable resistance and ammeter leads shown in red and voltmeter leads in blue. Connections are similar for both two-unit and three-unit 1118300 type regulator.

FIXED RESISTANCE METHOD—With the fixed resistance method, a fixed resistance is substituted for the external charging circuit by disconnecting the battery lead at the regulator and connecting the resistance between the regulator "BAT" terminal and ground. A test voltmeter is connected in parallel with the fixed resistance as shown in Figure 11. The resistance must be ¾ ohm* for 6 volt units, 1½ ohms* for 12 volt units, 7 ohms for 24 volt units, and must be capable of carrying 10 amperes without any change of resistance with temperature changes.

*NOTE: With all 6 volt regulators having current ratings less than 15 amperes, it is necessary to use a 1½ ohm fixed resistance to avoid interference from the current regulator. With all 12 volt regulators having current ratings less than 15 amperes, a 2¼ ohm fixed resistance (¾ ohm and 1½ ohm resistors in series) must be used for the same reason.

With generator operating at specified speed and with regulator at operating temperature, note voltage setting. Cover must be in place.

To adjust voltage setting, turn adjusting screw (Fig. 13). Turn screw clockwise to increase voltage setting and counterclockwise to decrease voltage setting.

CAUTION: If adjusting screw is turned down (clockwise) beyond normal adjustment range, spring support may fail to return when pressure is relieved. In such case, turn screw counterclockwise until sufficient clearance develops between screw head and spring support, then bend spring support upward carefully with small pliers until contact is made with screw head. Final setting of the unit should always be approached by increasing spring tension, never by reducing it. If setting is too high, adjust unit below required value, and then raise to exact setting by increasing spring tension.

If the unit is badly out of adjustment, refer to section headed REGULATOR SPRING REPLACEMENT.

After each adjustment and before taking voltage reading, replace the regulator cover, reduce generator speed until relay points open and then bring the generator back to speed again.

VARIABLE RESISTANCE METHOD—Connect ammeter into charging circuit at "BAT" terminal of regulator with ¼ ohm variable resistance in series. Connect voltmeter from regulator "BAT" terminal to ground as shown in Figure 12. Increase generator to specified speed. If less than 8 amperes is obtained (or less than 4 amperes on low output 6 and 12 volt generators), turn on lights to permit increased generator output. Cut in resistance until output is reduced to 8-10 amperes (4-6 amperes on 6 and 12 volt generators having current ratings less than 15 amperes). Operate until regulator reaches operating temperature. Retard generator speed until relay points open, then

NOTE—It is very important that the variable resistance be connected at the "BAT" terminal as shown in Figure 12 rather than at the "GEN" terminal, even though these terminals are in the same circuit. An examination of the wiring diagram, Figure 3, will show that regulation begins at the point where the shunt windings are connected to the series circuit. Any small resistance added to the circuit between the generator and this point will simply be offset by a rise in generator voltage without affecting the output shown at the ammeter.

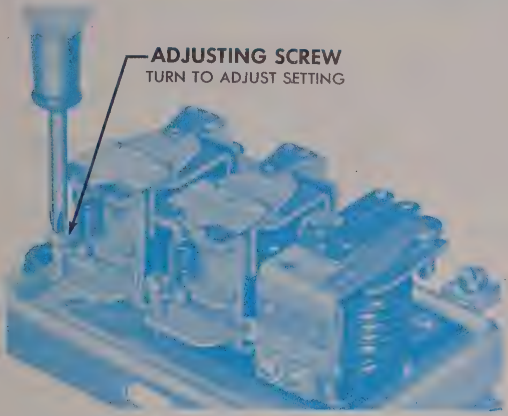

Figure 13—Adjusting voltage regulator setting.

bring generator back to speed and note voltage setting. Voltage readings must be taken with regulator at operating temperature and with 8-10 amperes flowing (4-6 amperes on low output units). Cover must be in place.

Adjust regulator as previously explained. In using the variable resistance method, it is necessary to readjust the variable resistance after each voltage adjustment, and then reduce and increase generator speed before taking the voltage reading.

Specified Generator Speeds for Adjusting the Voltage Regulator

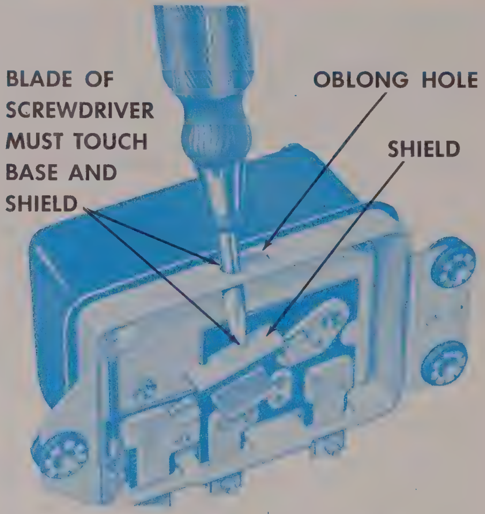

Figure 14—Quick method for cutting out voltage regulator in order to check current regulator setting.

1. For passenger cars and trucks, 3500 generator r.p.m.

2. Operating speed for constant speed engines (light aircraft engines included in this classification).

3. Governed speed for governed engines.

THREE-UNIT REGULATOR CHECKS AND ADJUSTMENTS

(See Delco-Remy Service Bulletin 1R-180 and 1R-185 for specifications)

The cutout relay and voltage regulator on the three-unit regulator are checked and adjusted in the same manner as the cutout relay and voltage regulator on the two-unit regulator.

CURRENT REGULATOR

Two checks and adjustments are required on the current regulator, air gap and current setting. The air gap on the current regulator is checked and adjusted in exactly the same manner as for the voltage regulator already described.

CURRENT SETTING—To check the current regulator setting, the voltage regulator must be prevented from operating. Four methods of preventing voltage regulator operation are available. Regardless of the method used, an ammeter must be connected into the charging circuit at the regulator "BAT" terminal. The first method should be used for preliminary checks whenever possible since it does not require removal of the regulator cover. The four methods are as follows:

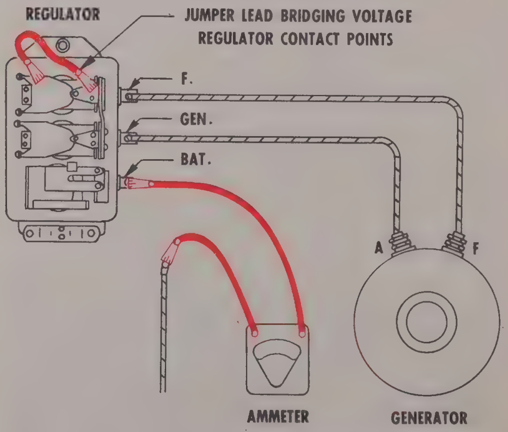

Figure 15—Ammeter and jumper lead connections for checking current regulator setting by the jumper lead method. Ammeter leads and jumper lead shown in red.

1. QUICK CHECK METHOD—Insert screwdriver blade through oblong hole in base of regulator until contact is made with shield around resistor (Fig. 14). Be sure to keep screwdriver at right angles to base, and hold firmly in place during check so that blade touches regulator base and shield at same time. This temporarily cuts out voltage regulator unit. Turn on lights and accessories to prevent high voltage during the test. With ammeter connected as in Figure 15 and regulator at operating temperature, operate generator at specified speed, and note current setting. If necessary to adjust, remove cover and adjust in same manner as voltage regulator unit (Fig. 13) by turning adjusting screw clockwise to increase current setting or counterclockwise to decrease setting. See CAUTION note under Voltage Setting of Voltage Regulator. If unit is badly out of adjustment readjust as explained under REGULATOR SPRING REPLACEMENT.

2. JUMPER LEAD METHOD—Remove the regulator cover and connect a jumper lead across the voltage regulator contact points (Fig. 15). Turn on lights and accessories to prevent high voltage during the test. With generator operating at specified speed and with regulator at operating temperature, note the current setting.

3. BATTERY DISCHARGE METHOD—Partly discharge battery by cranking the engine for 30 seconds with ignition turned off. Never use cranking motor more than 30 seconds continuously since this would overheat and damage it. Immediately after cranking, start engine, turn on lights and accessories and note current setting with generator operating at specified speed.

4. LOAD METHOD—If a load approximating the current regulator setting is placed across the battery during the time that the current regulator setting is being checked, the voltage will not increase sufficiently to cause the voltage regulator to operate. This load may be provided by a carbon pile or a bank of lights.

IMPORTANT—When adjusting any current regulator the following must be observed:

1. All generators must be operated at a speed sufficient to produce current in excess of specified setting.

2. Voltage of the generator must be kept high enough to insure sufficient current output. (With 35 ampere generators it may be necessary to maintain the voltage above the voltage regulator setting. This can be done, where necessary, by decreasing the load across the battery or by raising the state of charge of the battery.)

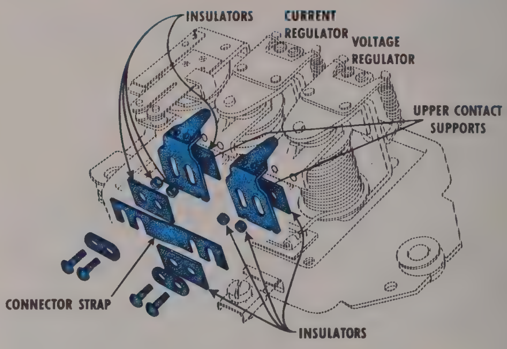

Figure 16—Relationship of insulators, connector strap and upper contact support brackets in three-unit regulator.

REPAIR SECTION

REGULATOR SPRING REPLACEMENT

If it becomes necessary to replace the spiral spring on either the current or voltage regulator unit, the new spring should first be hooked on the lower spring support and then stretched up until it can be hooked at the upper end. Stretch the spring only by means of a screwdriver blade inserted between the turns (or in a similar manner)—do not pry the spring into place as this is likely to bend the spring supports. After installing a new spring, readjust the unit setting as already described.

REPLACING CONTACT SUPPORT BRACKETS

Voltage or current regulator contact support brackets can be replaced by following the relationship illustrated in Figure 16. Note particularly that the connector strap is insulated from the voltage regulator contact mounting screws while it is connected to the current regulator contact mounting screws. New bushings should always be used when installing a contact support bracket since the old bushing may be distorted or damaged.

RADIO BY-PASS CONDENSERS

The installation of radio by-pass condensers on the field terminal of the regulator or generator will cause the regulator contact points to burn and oxidize so that generator output will be reduced and a run-down battery will result. If a condenser is found to have been connected to either of these terminals, disconnect the condenser and clean the regulator contact points as previously explained.

DELCO-REMY
SERVICE BULLETIN

BULLETIN 1C-100
Date 2-10-47
6 Pages Page 1
File Under:
C-IGNITION COILS

Supersedes Bulletin
1C-100 Dated 6-21-41

CONSTRUCTION, OPERATION AND MAINTENANCE OF

IGNITION COILS

The ignition coil is a pulse transformer that transforms or steps up the low battery or generator voltage to the high voltage necessary to jump the gaps at the spark plugs in the engine cylinders. This voltage may reach as much as 20,000 volts. Bulletin 1D-100 explains how this high voltage is distributed through the ignition wiring to the proper spark plug in the engine.

The ignition coil contains three essential parts: a primary winding consisting of a few hundred turns of relatively heavy wire, a secondary winding consisting of many thousand turns of very fine wire, and laminated soft iron which serves to concentrate the magnetic field. The primary winding is assembled around the outside of the secondary winding, and the laminated iron is distributed so that one portion serves as a core for the windings and the remainder as a shell around the entire subassembly. This subassembly is then placed in the coil case and the remaining space nearly filled with insulating compound or oil, and the coil cap assembled into place.

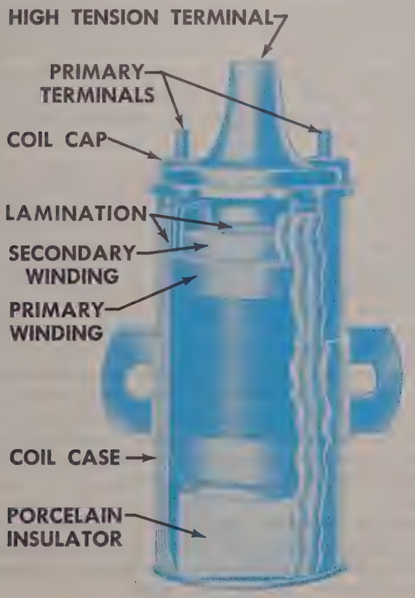

Figure 1—Cutaway view of a typical ignition coil.

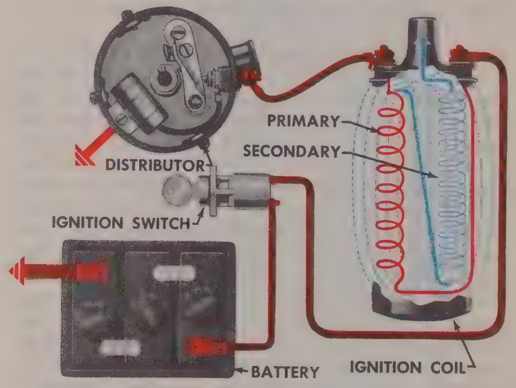

Figure 2—Schematic wiring diagram of the primary circuit of an ignition system. Primary circuit shown in red. Secondary winding of ignition coil and magnetic field shown in blue.

COIL OPERATION

Figure 2 illustrates schematically part of the circuit of an ignition system. The entire primary circuit is shown (in red) but of the secondary circuit, only the secondary winding of the coil (in blue) is shown. The remainder of the secondary circuit, which includes the distributor rotor and cap plus the high tension wiring and plugs, is illustrated and discussed in Bulletin 1D-100. In this bulletin we are concerned with how battery or generator voltage is transformed inside the ignition coil into the high voltage required to fire the spark plugs.

When the contact points in the ignition distributor close with the ignition switch turned on, current can flow from the battery through the primary winding of the ignition coil, through the contact points and back to the battery through ground.

1.2 GO, 1.2, 1S, 1PS, 1SS, 1F, 31, 72:1

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This flow of current in the ignition coil primary winding produces a magnetic field in the coil as indicated by the dotted blue lines (Fig. 2). However, the flow of current and thus the magnetic field, do not reach their maximum values instantly. A small fraction of a second (called build-up time) is required for this to occur.

This is characteristic of any coil because of the self-induction that occurs as current starts to flow through the coil. Self-induction produces a momentary countervoltage in the coil which opposes any change in the amount of current flowing. This countervoltage must be overcome by the battery voltage so that the value of current can increase to its maximum as determined by the resistance of the primary winding and circuit.

While the build-up time is comparatively short, it is a factor in ignition performance, particularly at high engine speed. At high speed the time that the contact points remain closed is so short that the current and thus the magnetic field cannot increase to their maximum values. For this reason in particular, ignition engineers must balance the entire ignition system with engine requirements so that adequate voltage will be available from the ignition coil even under the most adverse conditions.

During the time that the distributor contact points remain closed so that the flow of current is increasing, energy in the form of magnetic flux is being stored in the coil. That is, the strength of the magnetic field continues to increase (possibly reaching its maximum at low engine speed but not at high engine speed). Further rotation of the breaker cam brings the next cam lobe around to where it strikes the breaker lever rubbing block, thus causing the contact points to break.

Current attempts to continue to flow across the separating contact points because of the self-induction of the ignition coil. Self-induction opposes any change in the amount of current flowing in a winding. Thus the coil primary winding attempts to keep the current flowing in the primary circuit. If it were not for the ignition condenser which is connected across the contact points, current would continue to flow between the separating points. This current would form an arc which would burn the points badly and would also drain away most of the energy stored in the coil. There would be insufficient energy left in the coil to produce the necessary high voltage surge in the secondary.

The ignition condenser, however, provides a place where the current can flow during the first instant that the points begin to separate. The current thus flows into the condenser instead of forming an arc between the separating points. The amount of current that the condenser can thus accept is very limited so that the condenser becomes charged very quickly. The condenser thus acts both as a storage chamber for the current and as a check on the current which quickly brings the flow of current in the primary circuit to a stop. As the flow of current is thus halted, the magnetic field, which depends on this flow of current, decreases rapidly in concentration.

The very rapid change in the concentration of the magnetic field (or flux) causes a high voltage to be induced in every turn of both the primary and secondary windings. In the primary winding the voltage may reach a value as great as 250 volts, resulting in further charging of the condenser. In the secondary winding, which may contain up to 100 times as many turns of wire as the primary, the voltage could go as high as 25,000 volts (100x250).

Normally, however, the voltage does not increase to this value. It increases only to an amount sufficient to produce a spark at the spark plug gap connected to the ignition coil secondary through the distributor rotor, cap insert and high tension lead. This voltage is usually somewhere between 4,000 and 18,000 volts, the actual value depending upon such variables as engine compression, speed, mixture ratios, width of spark plug gap, spark plug temperatures, etc.

As the spark appears at the spark plug gap the energy in the coil (stored in the form of magnetic flux) begins to drain from the coil through the secondary circuit, thus sustaining the spark for a small fraction of a second or for several degrees of crankshaft revolution. During this interval the condenser discharges back through the primary circuit producing an oscillation of the current flow in the primary circuit during the brief interval that is required for the primary circuit to return to a state of equilibrium. Note particularly that the ignition condenser *does not* discharge until *after* the spark has occurred at the spark plug gap. This is in contrast to former theories, now disproved, regarding condenser action.

The above sequence of action is repeated as each lobe of the breaker cam moves under and past the rubbing block on the breaker lever to cause the contact points to close and open.

TYPES OF IGNITION COIL

Delco-Remy supplies a variety of ignition coils for various types of operation, with each type of coil being supplied in several models, each designed to incorporate a specified winding to make it suitable for operation with a particular engine under specific operating conditions.

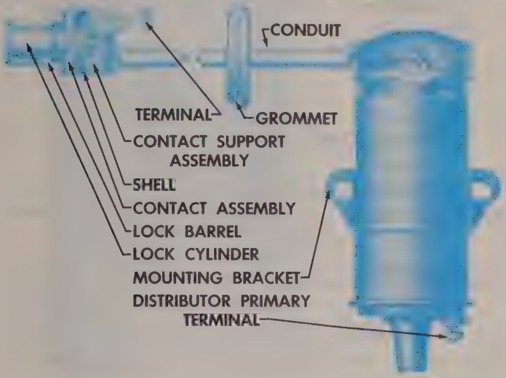
CONDUIT
TERMINAL
GROMMET
CONTACT SUPPORT ASSEMBLY
SHELL
CONTACT ASSEMBLY
LOCK BARREL
LOCK CYLINDER
MOUNTING BRACKET
DISTRIBUTOR PRIMARY TERMINAL

Figure 3—Lock extension coil with the lead between the coil and ignition switch protected by armored cable.

It will be appreciated that no one coil will be suitable for all types of operation because of the wide range of operating conditions and the great variety of internal combustion engines requiring ignition equipment. Figures 1, 3, 4, 5, 6, and 8 illustrate some of the various types of ignition coil Delco-Remy manufactures. Figure 3 is a lock extension coil which uses armored cable or conduit connection between the ignition lock and the coil as a deterrent against theft of the automobile. Figure 7 illustrates the manner in which the coil end-cover is removed from this type of coil.

Figure 4 illustrates an oil-filled and hermetically sealed ignition coil that has been in widespread use in recent years. Hermetic sealing of the ignition coil prevents the entrance of moisture which would ultimately cause coil failure. Moisture may enter an unsealed coil either directly in the form of rain, snow, washing water, steam, and so forth, or through the "breathing" action of the coil itself. Unless a coil is hermetically sealed it will expel air when heated and will draw in outside air when cooled. This is the action termed "breathing," and it results in a gradual accumulation of water in the coil interior because of the condensation of water vapor from the incoming air. In addition to hermetic sealing, the coils are also filled with oil, as shown in Figure 4, to impart high dielectric strength to the insulation, thus further reducing the possibility of insulation breakdown and coil failure.

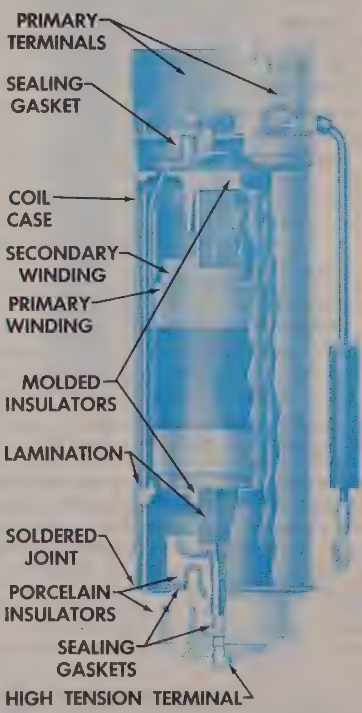
PRIMARY TERMINALS
SEALING GASKET
COIL CASE
SECONDARY WINDING
PRIMARY WINDING
MOLDED INSULATORS
LAMINATION
SOLDERED JOINT
PORCELAIN INSULATORS
SEALING GASKETS
HIGH TENSION TERMINAL

Figure 4—Cutaway view of a hermetically sealed and oil-filled ignition coil.

Figure 5 illustrates another hermetically sealed and oil-filled coil. Oil-filling has been found superior to other methods of waterproofing because it completely displaces all air from the exposed turns of the winding. Even very small air pockets greatly accelerate oxidation of insulation and may also cause radio interference. Note that sealing

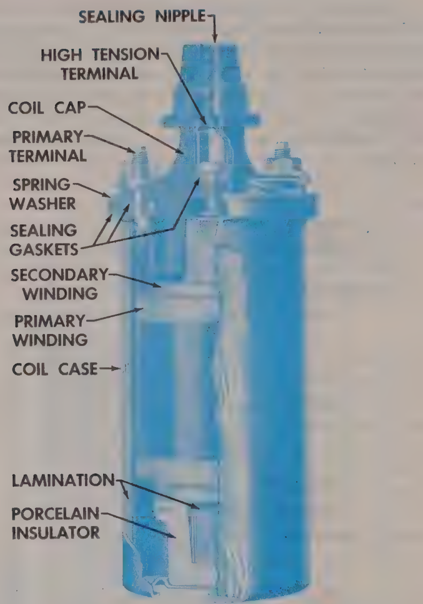
SEALING NIPPLE
HIGH TENSION TERMINAL
COIL CAP
PRIMARY TERMINAL
SPRING WASHER
SEALING GASKETS
SECONDARY WINDING
PRIMARY WINDING
COIL CASE
LAMINATION
PORCELAIN INSULATOR

Figure 5—Cutaway view of a hermetically sealed and oil-filled ignition coil which has a one-piece case.

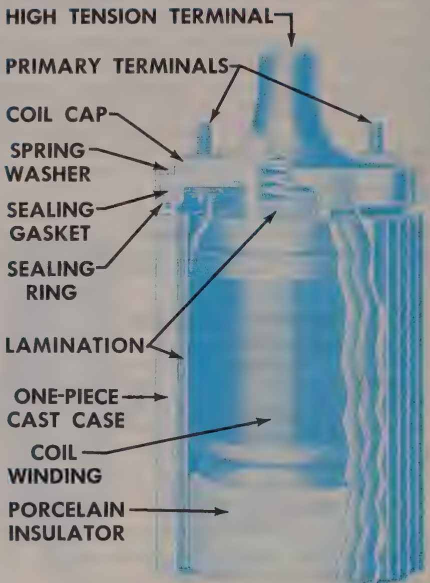
HIGH TENSION TERMINAL
PRIMARY TERMINALS
COIL CAP
SPRING WASHER
SEALING GASKET
SEALING RING
LAMINATION
ONE-PIECE CAST CASE
COIL WINDING
PORCELAIN INSULATOR

Figure 6—Cutaway view of a heavy-duty ignition coil which is hermetically sealed and oil filled and which has a one-piece cast case with fins.

gaskets are employed not only at the joint between the coil caps and the coil case, but also around both the primary and secondary terminals. The coil case is a one-piece drawn case without seams so that only one joint must be sealed to secure hermetic sealing.

Figure 6 illustrates a heavy-duty ignition coil used on motor-coach, truck and marine applications. This coil also is hermetically sealed against the entrance of air or moisture and is oil filled for greater insulation protection. The fins cast in the one-piece case plus the oil filling permits improved heat radiation which is a factor in efficient ignition coil performance.

COIL SERVICE

Ignition coils do not normally require any service except to keep all terminals and connections clean and tight. In addition, the coil should be kept reasonably clean but it must not be subjected to steam cleaning or similar cleaning methods which may cause moisture to enter the coil unless it is of the hermetically sealed type. Rubber nipples on the high voltage terminals are valuable in preventing "tracing" or leakage of current across exposed surfaces.

If poor ignition performance is obtained and the coil is suspected of being the cause, the coil may be tested on the car or it may be removed for the test. Lock extension coils are removed as illustrated in Figure 7. The procedure is as follows:

1. Insert a thin blade of spring steel about 0.015 inch thick (½ inch wide) between the coil can and the coil end-cover at a point approximately 1 inch to the left of the cable or seam on the coil can as shown.

2. Push tool between the lock and recess as shown to unlock the end-cover.

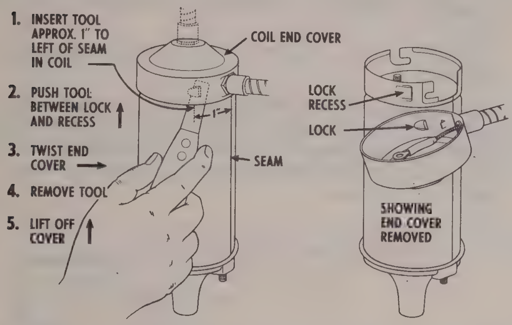
1. INSERT TOOL APPROX. 1" TO LEFT OF SEAM IN COIL
2. PUSH TOOL BETWEEN LOCK AND RECESS
3. TWIST END COVER
4. REMOVE TOOL
5. LIFT OFF COVER
COIL END COVER
1"
SEAM
LOCK RECESS
LOCK
SHOWING END COVER REMOVED

Figure 7—Procedure for removing coil end-cover from a lock extension coil.

3. Twist the end-cover as indicated until the lock is moved past the recess.
4. Remove the tool and lift off the end-cover. The lead can then be disconnected from the terminal on the coil.

To reassemble, connect the lead, align the locating lugs on the end-cover with the slots in the coil so that the lock will be on the same side as the lock recess. Press cover down and twist until the lock snaps into the recess.

IGNITION COIL TESTS

Two types of testing instrument are used in testing ignition coils. One of these makes use of an open or protected spark gap, while the other reports the coil condition on a meter. This second type of tester is usually so designed as to permit testing of the coil without making any connection to the secondary terminal. This eliminates certain variables caused by altitude, atmospheric or spark gap electrode conditions which are usually present in the spark gap type of test.

The spark gap tester should always be used comparatively. That is, a coil known to be good should be compared with the questionable coil. Both coils should be at the same temperature and identical test leads must be used.

Before the testing instrument is used a lamp and test points should be applied to check the coil for open or grounded circuits. To test for an open primary circuit, put the test points on the two primary terminals. If the lamp does not light, the primary circuit is open. To check the secondary circuit put one test point in the high tension terminal and the other at one of the primary terminals. The lamp will not light but tiny sparks will be noted as the test points are rubbed over the terminals if the secondary winding is not open. If the secondary is open no sparks will occur.

Most ignition coils can be tested for grounded windings by placing one test point on a clean part of the metal container and touching the other point to the primary and high tension terminals. If the lamp lights or tiny sparks appear at the points of contact, the windings are grounded.

> NOTE: This test does not apply to the secondary windings of coils used on insulated or two-wire electrical systems since these coils have one end of the secondary winding grounded to the metal container. The primary winding of this type coil, however, may be checked for ground.

When using a meter type coil tester to test a coil without removing it from the car, be very careful to avoid touching the tester case to the car. Many such testers have a ground connection to the case; touching the case to the car would produce a short circuit and possible serious damage to the equipment.

Details of the testing procedures and the manner in which the various testers are used will be found in the tester operating instructions.

IGNITION CONDENSER TESTS

In order to test an ignition condenser a special condenser tester must be used. Such a tester will check the condenser for insulation breakdown, low insulation resistance, high series resistance and capacity. All four of these are characteristics which affect ignition performance. Further details of this matter will be found in Bulletin 1D-150. Note particularly the section pertaining to contact point pitting in that bulletin.

VIBRATOR IGNITION COIL

The vibrator ignition coil (Fig. 8) is a special ignition coil which contains, in addition to the primary and secondary windings, a pair of contact points and a condenser (Fig. 9). This ignition coil is used primarily to improve starting of Diesel engines.

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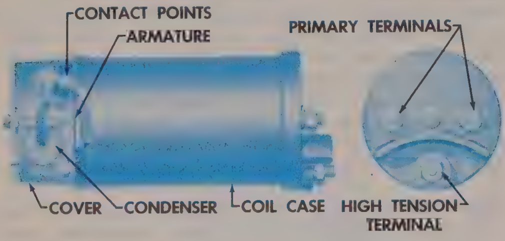

Figure 8—Vibrator ignition coil partly cut away to show contact points, armature and condenser.

OPERATION

The ignition switch is usually held open by a spring. When it is closed, current flows through the contact points and coil primary winding. This builds up a magnetic field which attracts the armature so that the contact points open. As the points open the magnetic field collapses to induce a high voltage surge in the secondary winding. This produces a spark at the spark gap. At the same time, the collapse of the magnetic field releases the armature so the contact points close again. This cycle is repeated very rapidly so that a stream of high voltage surges emanates from the secondary winding of the coil. This stream of sparks may be used to ignite a spray of oil in the intake manifold of a Diesel engine for easier starting at low temperatures, thus producing a preheating effect during initial cranking of the engine.

VIBRATOR IGNITION COIL SERVICE

The armature or condenser can be replaced by removing the nut and lock washer, the nut being soldered to the contact screw. When replacing the screw, be sure to resolder the nut after the contact points are readjusted.

The contact points may be cleaned with a few strokes of a clean, fine-cut contact file. Never use sandpaper or emery cloth since particles of emery or sand may embed and cause rapid point burning.

ADJUSTMENT

To adjust the contact points, loosen the locking nut and turn the contact screw in or out to secure 0.018 inch point opening with the armature held down against the core. The coil should be tested after adjustment to make sure that it can deliver rated performance. It may sometimes be necessary to adjust the spring tension of a newly installed armature slightly to obtain satisfactory performance.

TESTING

Test the coil by connecting the two primary terminals to a 6-volt battery. The coil should produce a spark ⅛ inch long on a regular spark gap tester. If a spark of this length is not obtained, check further as follows:

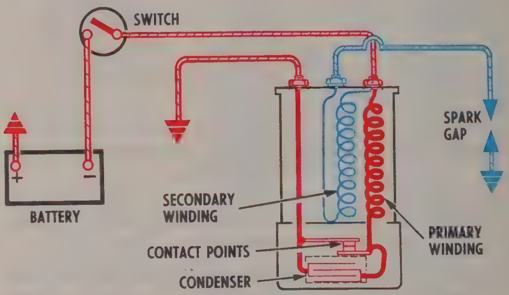

Figure 9—Schematic wiring diagram of a vibrator ignition coil and external circuit. Primary circuit shown in red and secondary circuit in blue.

Note if the contact points open when the 6 volts are applied. If they do not open they may be out of adjustment or the primary circuit may be open inside the coil. The primary circuit may be checked for open with a set of test points and a lamp while the point opening can be checked as already explained. If the points do vibrate but no spark is obtained, then the trouble is likely due to a defective condenser or to weak armature spring tension. The condenser can be tested on a coil tester and if it is in good condition then the armature spring tension should be increased slightly. Only a very slight readjustment of the spring tension will be required. *Avoid excessive bending.* If the points open and do not close again the condenser is probably shorted.

The contact points can be blocked closed so that the coil can be tested on a meter-type coil tester. Several coils of this type known to be good can be tested to obtain standard or average readings on the tester and then questionable coils can be compared to this average reading.

VENDOR: Hallett Manufacturing Company	INSTALLATION INSTRUCTIONS FOR KIT 4034-A

This shielding, when properly installed, will satisfactorily attentuate radio interference to comply with Specification MIL-S-10379.

GENERAL INSTALLATION INSTRUCTIONS

In order to assure proper functioning of the shielding, it is extremely urgent that all electrical components and the shielding for same are operating at one common ground potential. This can best be achieved by:

A Scraping and removing all paint or rust from the distributor, coil, etc., wherever contact will be made with the shielding enclosure.

B Providing additional grounding connections to the shields by means of the flexible jumpers which have been provided.

C Making certain that all coupling nuts, shield covers, and other ground connections are tight.

The importance of utilizing tooth type lockwashers cannot be overemphasized. These lockwashers should be utilized wherever a grounding application is evident. Typical examples are:

A Grounding straps.

B Capacitors.

C Mounting locations for the distributor, coil, generator, and regulator.

D Mounting locations of the engine to the balance of the unit.

The high tension wiring, the primary ignition wiring, and the battery charging generator circuit wiring shall not be routed any closer than necessary to each other or combined with auxiliary wiring.

1 Distributor Shield

A Remove the paint from the distributor bowl where the base clamps to it. Fasten the shield base to the distributor in position so that the adaptor holes in the cover align properly with the outlets on the bakelite distributor cap. Tighten the screws and clamp screws.

B Fasten the shielded low tension coil to distributor lead to the shield base and fasten the terminal.

C Fasten the cover in position and tighten the retaining screws. Re-check the high tension outlet alignment with the bakelite distributor cap.

D Fasten the bond strap to the shield and to a convenient screw on the engine to assure proper ground of the shield.

II Coil Cap Shield

A Remove the paint from the coil body where the shield clamps to it. Fasten the clamping halves and tighten the clamping screws.

B Fasten the low tension coil to distributor lead to the proper terminal post. Fasten a #4465 O. I. MFD capacitor in the shield and fasten its terminal and the switch lead on the other coil terminal post.

C Fasten the shield cover and tighten the retaining screws.

D Fasten the bond strap to the shield and to a convenient screw on the engine to assure proper ground of the shield.

III High Tension Shielded Lead Assemblies

A Fasten the 5/8-24 nut of the elbow end of the shielded spark plug lead assemblies to the spark plugs. Attach the other ends to the proper towers of the cap in the distributor shield.

B Attach bakelite end of the high tension coil to distributor lead to the high tower of the cap in the distributor shield. Care should be taken not to break the brittle bakelite assembly. The other end is attached to the coil tower. Tighten all lead retaining nuts securely. This is important for proper functioning of the shielding. Adjust the distributor and coil shielding, if necessary, to maintain 1/8" spring compression at the contactors in the secondary unit circuit.

IV Generator "Field" and "Armature" Lead Assemblies

Attach the field and armature leads to the proper leads in the generator. Ground the pigtail parts of the leads to the generator frame using any convenient screw. Attach at the regulator ends to the proper terminals. At the grounds utilize the internal tooth lockwashers.

V Battery Charging Generator

A Fasten #4465 O.I. MFD capacitor to generator frame and fasten terminal to armature terminal post. The capacitor retaining screw must be used with a tooth type lockwasher and the paint must be removed where the capacitor mounts to the frame to insure good grounding.

VI Voltage Regulator

A Fasten 2 #4465 O.I. MFD capacitors to the regulator case, fastening the terminal of one to the battery terminal and the terminal of the other to the armature terminal. The capacitor retaining screw must be used with a tooth type lockwasher and the paint must be removed where the capacitor mounts to the case to insure good ground.

VII Ventilation

A Screw 2511 Pitot tube in carburator neck with the stem pointing down the air stream.

B Connect the Pitot tube and distributor shield with the 4254 tubing.

VIII Inspection

A Check all shield joint fasteners to be sure that they are tight. This is important for proper shield function.

This shielding does not alter any of the prime ignition components such as the coil, distributor, etc., in any way. Refer to the equipment manufacturing service and maintenance manuals for any information needed regarding these parts.

SERVICE INSTRUCTIONS

Spicer

Needle Bearing Universal Joints

SPICER MANUFACTURING

DIVISION OF DANA CORPORATION

TOLEDO 1, OHIO

Bulletin No. J-261 **January 1, 1949**

Supersedes Bulletin No. 153

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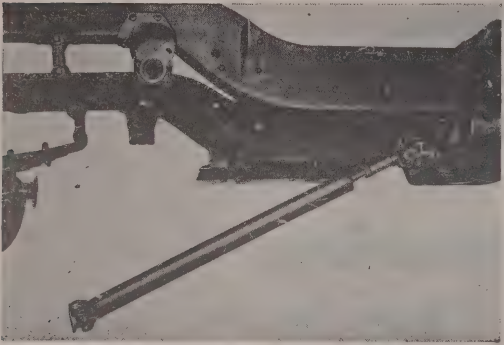
11-51-AP-1

Printed in U.S.A.

Service Instructions

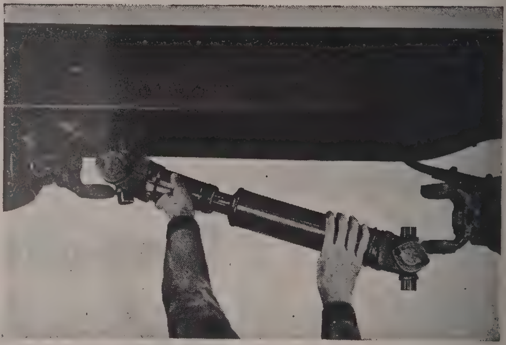
Spicer Needle Bearing Joints are simple in construction, easily removed from the vehicle, readily disassembled and reassembled without the use of any special tools or any special mechanical knowledge.

A. REMOVAL FROM THE VEHICLE



1. DOUBLE FLANGE YOKE TYPES (BEARING CAP AND SNAP RING CONSTRUCTION)

All Double Flange Yoke Type Joints are removed as a complete assembly by removal of the Companion Flange Bolts, Nuts, and Lockwashers, which allows the assembly to slip out from between the Companion Flanges.



2. DOUBLE END YOKE TYPE (BEARING CAP CONSTRUCTION)

Remove the Cap Screws, Lock Plates and Bearing Caps, take out the self-contained Bearings in the lugs of the End Yokes, and remove the Propeller Shaft with the remaining Journal Crosses and Bearings as a unit. The End Yokes remain on the vehicle.

DOUBLE END YOKE TYPE (U-BOLT CONSTRUCTION)

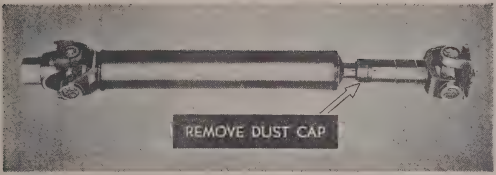
3. DOUBLE END YOKE TYPE (U-BOLT CONSTRUCTION)

Remove the U-Bolts, Nuts, and Lockwashers from the End Yokes. Slide the Sleeve Yoke toward the shaft to free the Bearings from their seats between the shoulders in the End Yokes. Care should be taken not to drop the two Bearings from the trunnion ends of the Journal Cross at both ends of the Propeller Shaft. The End Yokes remain on the vehicle.

4. FLANGE YOKE AND END YOKE (COMBINATION TYPE)

Joints may be Flange Yoke construction on one end and End Yoke on the opposite end, with either or both ends constructed in Bearing Cap, Snap Ring, or U-Bolt design. Removal instructions are followed out as given under A-1, -2, and -3.

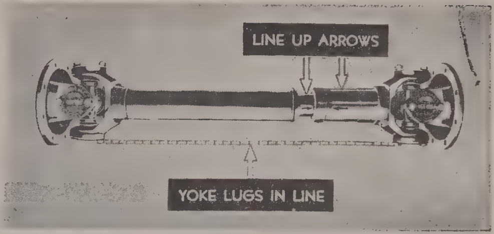
Service Instructions—Continued



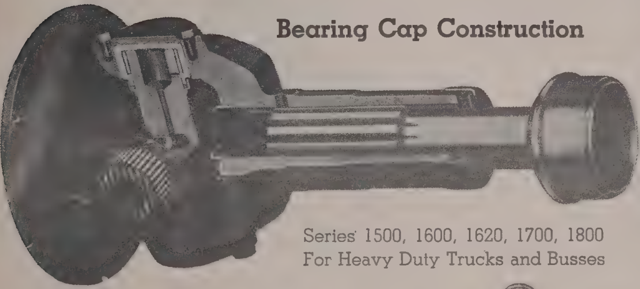
B. REMOVAL OF THE SLIP JOINT

1. Slip Joint (All Types).

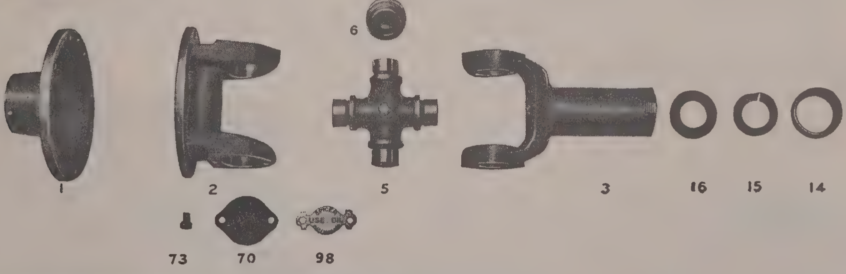
Unscrew the Dust Cap from the Sleeve Yoke and slide the Joint off from the Propeller Shaft.



2. ARROW MARKS—Make sure arrow marks are stamped on the Shaft and Sleeve Yoke before removing the Slip Joint. If arrow marks are not readily seen, mark both members so that when reassembled they will be in exactly the same relative position, as the Sleeve Yoke lugs must be in the same plane as the Stub Ball Yokes to prevent excessive vibration in operation.


Bearing Cap Construction

Series 1500, 1600, 1620, 1700, 1800
For Heavy Duty Trucks and Busses

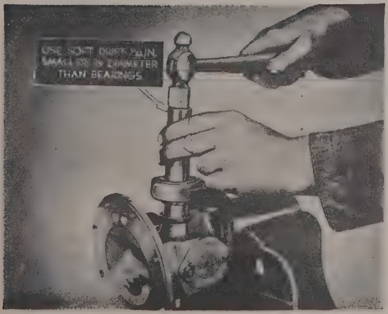


C. DISASSEMBLING UNIVERSAL JOINT—BEARING CAP CONSTRUCTION.

1. LOCK STRAP (98)—Bend down the locking lugs with a screwdriver and remove the Cap Screws (73) and the Bearing Caps (70).

2. NEEDLE BEARINGS (6)—Remove by first tapping with a soft round drift on the exposed face of one Needle Bearing until the opposite Needle Bearing comes out. Turn the Joint over and tap the exposed end of the Journal Cross (5) until the opposite Needle Bearing is free. Use a soft round drift with flat face about 1/32″ smaller in diameter than the hole in the Yoke, otherwise there is danger of damaging the Bearing.

3. JOURNAL CROSS (5)—Remove by sliding it to one side of the Yoke and tilting it over the top of the Yoke lug.



Service Instructions—Continued

D. CLEANING AND INSPECTION

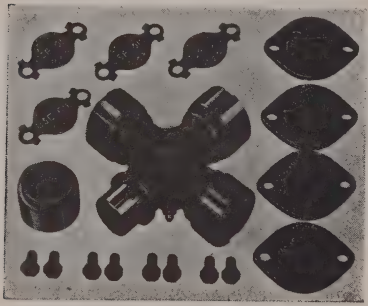
1. CLEAN ALL PARTS—Use a suitable cleaning fluid. Allow the parts to remain in the cleaner for some time to loosen up any particles of grease or foreign matter. Remove any burrs or rough spots from any machined surfaces.

2. NEEDLE BEARING (6)—Do not disassemble. Clean with short stiff brush and blow out with compressed air. Work a small quantity of lubricant (140 S.A.E. Oil) into each Needle Bearing and turn the Needle Bearing on the trunnion to check wear. Replace if worn.

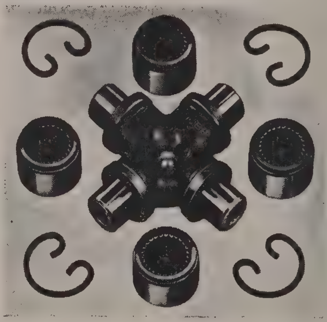
3. JOURNAL CROSS (5)—Because worn Needle Bearings used with a new Journal Cross or new Needle Bearings used with a worn Journal Cross will wear more rapidly making another replacement necessary in a short time, always replace the Journal Cross and four Needle Bearings as a unit.

4. JOURNAL AND BEARING KIT—To facilitate the replacement of Journals and Bearings, a Journal and Bearing Kit is available. The use of the Kit insures having the correct individual parts when required and saves valuable time.

JOURNAL AND BEARING KITS



Bearing Cap Construction



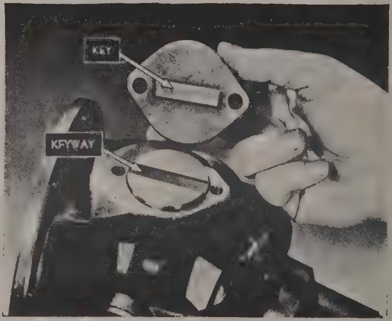
Snap Ring Construction

E. ASSEMBLING UNIVERSAL JOINT

1. GASKET (86)—If unnecessary to install a NEW KIT make sure that four NEW GASKETS are installed in the Journal Retainers.

2. JOURNAL CROSS—With the Relief Valve facing the Flange Yoke insert one trunnion of the Journal Cross into the bearing hole in the Yoke lug from the inside between the lugs and tilt until the trunnion of the Journal Cross will enter the hole in the opposite Yoke lug.

3. NEEDLE BEARING—Insert from outside of Yoke. Press into place with an arbor press or tap with a soft round drift so as not to mar any surfaces.



4. BEARING CAP—Make sure that the Key on the Bearing Cap fits into its keyway on the back of the Needle Bearing. VERY IMPORTANT.

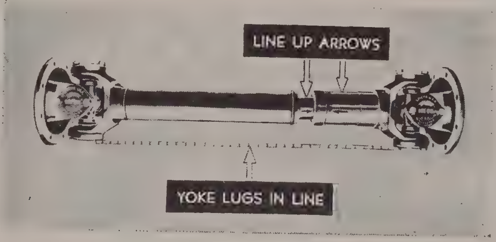
5. LOCK STRAP and CAP SCREWS—Assemble and bend the lugs of the Lock Strap up against the flat of the Cap Screw. If the Joint appears to bind tap the lugs lightly to relieve any pressure of the Bearing on the end of the Journal.

Service Instructions—Continued

F. ASSEMBLING SLIP JOINT ON SHAFT

1. SLIP JOINT—Lubricate the splines thoroughly with 140 S.A.E. Oil and assemble on the Shaft. BE SURE that the arrows or marks on the Shaft and Slip Joint are in line, since the Sleeve Yoke Lugs must be in the same plane as the Stub Ball Yoke lugs to prevent excessive vibration.

2. CORK WASHER—Renew if necessary before assembling with the Dust Cap and Steel Washer on the Sleeve Yoke.



G. INSTALLING PROPELLER SHAFT

1. PROPELLER SHAFT ASSEMBLY—Place in a pair of centers and check the Shaft for runout. The runout on the Tube should not be more than .020″ indicator reading, and on the neck of the Slip Stub Shaft the runout should not be more than .005″ indicator reading. Mark the high and low points on the shaft with chalk and straighten if necessary. Install with the Slip Joint nearest the source of power.

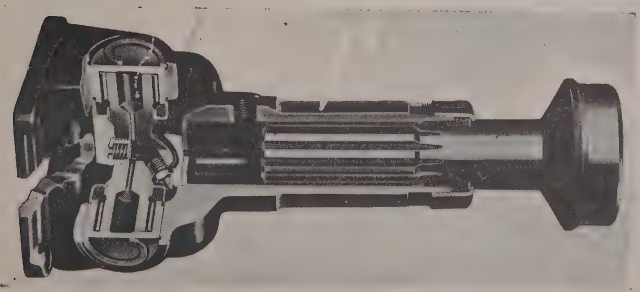
2. DOUBLE FLANGE YOKE TYPE—Tighten the Flange Bolts evenly after the Nuts and NEW lockwashers are in place.

3. DOUBLE END YOKE TYPE—Follow the instructions E-2, 3, 4 and 5 for "ASSEMBLING UNIVERSAL JOINT."

4. DOUBLE END YOKE TYPE—U-Bolt Construction—With a "C" * clamp over the two opposite Needle Bearings draw into position between the shoulders on the End Yoke. Assemble U-Bolts, Nuts, and Lockwashers.

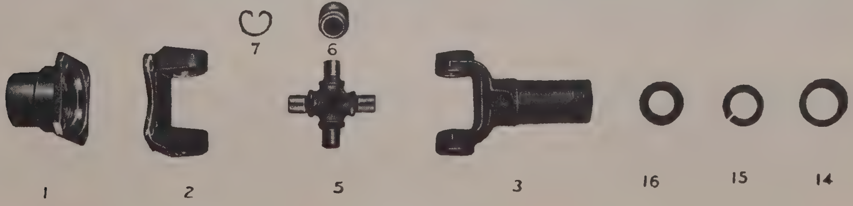
5. COMBINATION FLANGE YOKE AND END YOKE TYPE—Follow instructions G-2, 3 and 4 above.

(*) A "C" Clamp designed especially for this work, Tool No. J-881, may be obtained from Hinkley Myers Co., Jackson, Michigan.



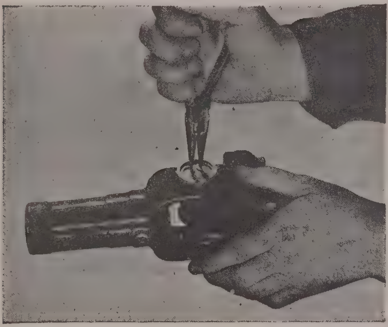
Snap Ring Construction

Series 1100, 1200, 1220, 1250, 1260, 1270,
1280, 1290, 1300, 1310, 1320,
1350, 1400, 1410
For Passenger Cars, Light Trucks and Busses



Service Instructions—Continued

H. DISASSEMBLING UNIVERSAL JOINT—SNAP RING CONSTRUCTION



1. SNAP RING (7)—Remove by pinching the ends together with a pair of pliers. If a ring does not readily snap out of the groove in the yoke tap the end of the Needle Bearing (6) lightly to relieve the pressure against the ring.

2. NEEDLE BEARING (6)—Remove by driving on the end of one Needle Bearing until the opposite Needle Bearing comes out. Turn the Joint over and tap the exposed end of the Journal Cross (5) until the opposite Needle Bearing is free. Use a soft round drift with flat face about 1/32" smaller in diameter than the hole in the Yoke, otherwise there is danger of damaging the Bearing.

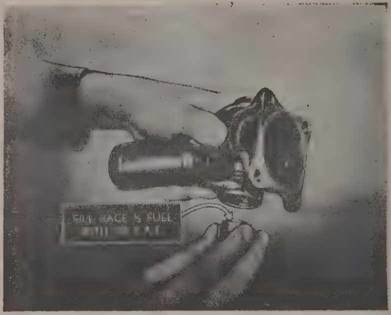
3. JOURNAL CROSS (5)—Remove by sliding it to the side of the Yoke and tilting it over the top of the Yoke Lug.

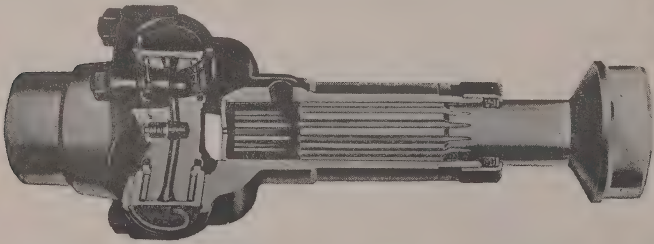
I. CLEANING AND INSPECTION

For sequence of operations—See Bearing Cap Construction.

J. ASSEMBLING UNIVERSAL JOINT

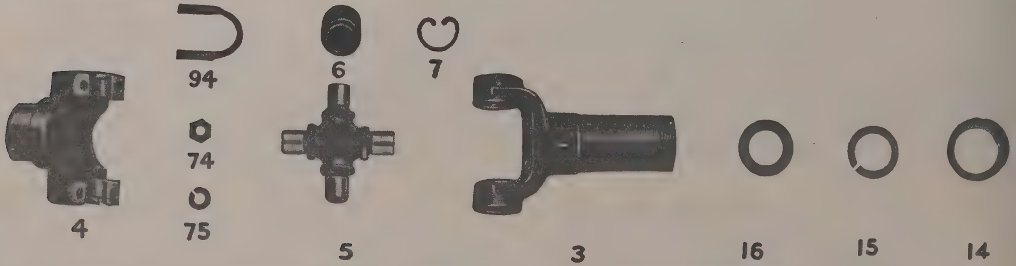
Reassembling is merely a reversal of the above operations. On Joints without a lubrication fitting repack reservoirs in the Journal Cross Ends with a good grade of semi-fluid lubricant (140 S.A.E.). Make sure the reservoirs in each trunnion are filled. With the rollers in the race fill the race about 1/3 full.





U-Bolt Construction

Series 1260, 1270, 1280, 1290
Series 1310, 1350, 1410
For Passenger Cars, Light Trucks and Busses



K. DISASSEMBLING UNIVERSAL JOINT—U-BOLT CONSTRUCTION

Joints are a combination of U-Bolt and Snap Ring Construction. U-Bolts are disassembled when the complete propeller shaft is removed from the vehicles (see instructions A-3). For balance of disassembly see instructions H and I. For assembly see Instruction J.

Suggestions for Proper Installation
of
Spicer Universal Joints

TWO-JOINT PROPELLER SHAFT

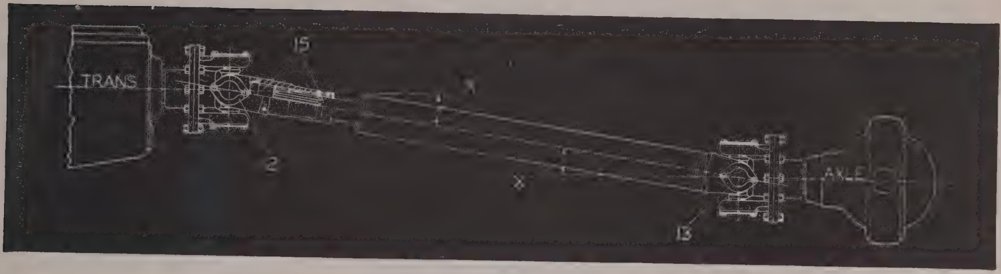


Fig. 1

It is of primary importance that Universal Joints of sufficient capacity be used.

When assembling the Slip Joint on the Shaft, care must be taken to place the Sleeve Yoke Lugs (12) in the same plane as the Shaft Yoke Lugs (13). Arrows will be found stamped on the Sleeve and Shaft for this purpose.

The Shaft Tube must not run out to an indicator reading in excess of .020″ and the neck of the Slip Spline .005″.

Install Transmission so that the Transmission Mainshaft and Axle Pinion Shaft are parallel or nearly so, in order to keep the angles (X) on both Joints as nearly equal as possible. See Fig. 1. If this method results in angles (X) of more than 12°, use the method shown in Fig. 2, where the Axle Pinion Shaft is tilted upward to enable the centerlines to intersect at a point midway between the Joint Centers, thus giving equal angles (Y).

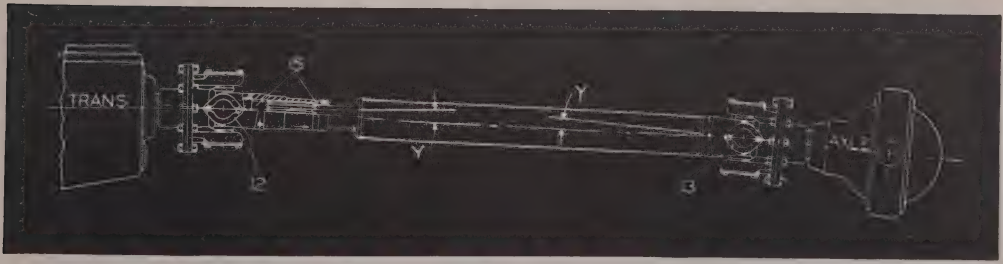


Fig. 2

When a Propeller Shaft Brake (14) is used, (See Fig. 3, page 8) care must be taken to see that the Brake Drum is properly piloted and runs true and in BALANCE.

Care must also be taken to see that the slip movement of the Spline Shaft in the Sleeve Yoke will have sufficient clearance (15) in both directions under extreme operating conditions.

THREE-JOINT PROPELLER SHAFT

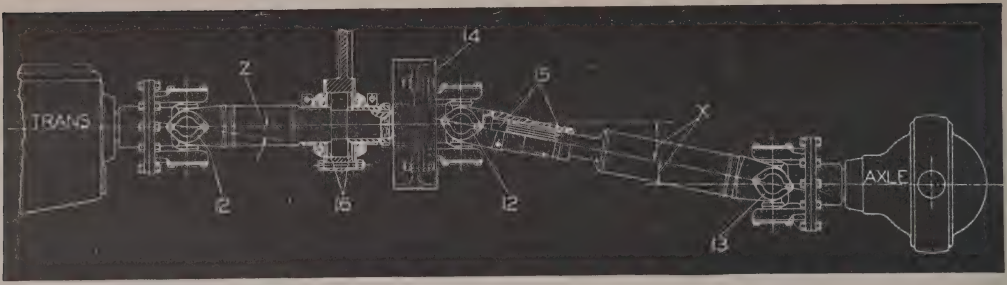


Fig. 3

All instructions given for Two-joint Propeller Shaft installation apply for the Three-Joint Shaft, with the following additions:

The front Joint at the Transmission should be installed so that the angle (Z) is not in excess of 3°.

The Amidship Bearing Box should be square (at right angles) with the center-line of the front Propeller Shaft.

When floating type Bearing Boxes are used, be sure that the Bearing has sufficient clearance at both ends of the Box (16) to permit longitudinal movement of the Bearing and also does not bind in the bore of the box.

When fixed type Bearing Boxes are used and the Bearing does not float lengthwise, a Slip Joint must be installed on the front Shaft instead of a Non-Slip Joint as shown in the cut.

When a Propeller Shaft Brake (14) is used, care must be taken to see that the Brake Drum is properly piloted and runs true and in BALANCE.

Care must also be taken to see that the slip movement of the Spline Shaft in the Sleeve Yoke will have sufficient clearance (15) in both directions under extreme operating conditions.

SHORT COUPLED JOINTS

Short Coupled Joints must be installed so that the front and rear Joints will have equal angles as shown in Fig. 1 which should not exceed 3°.

For Joint alignment and Brake mounting, see instructions covering Two- and Three-Joint Propeller Shaft installation.

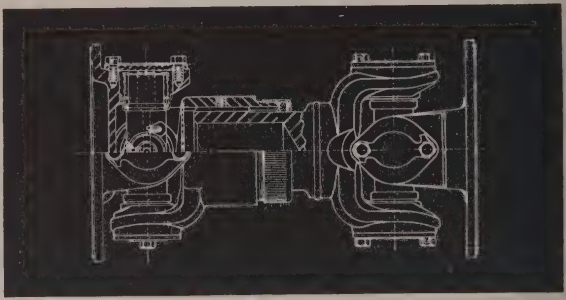


Fig. 4

Lubrication

Lubricate Needle Bearings with 140 S.A.E. Oil

DO NOT USE GREASE in SPICER NEEDLE BEARING Joints as grease is liable to clog the oil passages. On Joint Sizes 1260, 1270, 1280, 1290, 1310, 1350, 1400, 1410, 1500, 1600, 1620, 1700 and 1800 USE 140 S.A.E. Oil. Lubricate every 2,000 to 3,000 miles through the high pressure lubrication fitting provided on the Journal Cross. The lubricant is forced by centrifugal action from a central chamber in the Journal Cross to all four reservoirs, and then directly to the Needle Bearings where it is actually required.

A Relief Valve assembled to the central chamber of the Journal Cross, on Joint Sizes 1350, 1400, 1410, 1500, 1600, 1620, 1700 and 1800 prevents damage to the oil seals or gaskets when extremely high pressure is used to force in the lubricant. The Relief Valve also serves as an indicator to show when the joint is completely filled.

The Needle Bearings are well protected against oil leakage and the ingress of foreign matter by the liberal gaskets provided.

Joints manufactured without the lubrication fitting in the Journal Cross are lubricated at the factory and require very little attention. As a matter of precaution, the Joints should be removed from the vehicle every 15,000 miles, disassembled, cleaned and lubricated with 140 S.A.E. Oil.

The Sliding Spline Shaft should be lubricated through the high pressure fitting on the side of the Sleeve Yoke with a good grade of chassis lubricant every 2,000 to 3,000 miles or every time the chassis is lubricated.

ROSS GEAR AND TOOL COMPANY

LAFAYETTE, INDIANA, U. S. A.

SERVICE BULLETIN No. 398

Adjustment and Lubrication - Twin-Lever Roller Mounted Type Ross Cam and Lever Steering Gears

ADJUSTMENTS

When making adjustments free the steering gear of all load, preferably by disconnecting the drag link from the steering arm, and loosen the instrument board bracket clamp on steering gear jacket tube.

If the ball thrust bearings on the cam must be adjusted, make this adjustment (I) before making the side adjustment (II).

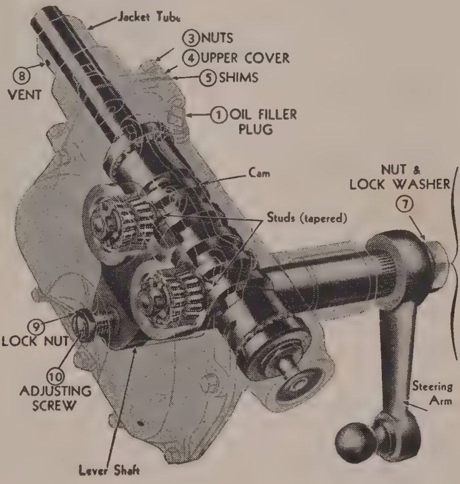
I. ADJUSTMENT OF BALL THRUST BEARINGS ON CAM

Adjust to a barely perceptible drag but allow the steering wheel to turn freely (with the thumb and forefinger lightly gripping the rim).

Before making this adjustment loosen the housing side cover adjusting screw (9, 10) to free the studs in the cam groove.

To Adjust, unscrew the four nuts (3) and move up the housing upper cover (4) to permit removal of shims (5). Shims are of .002", .003" and .010" thickness.

Clip and remove a thin shim or more as required. Tighten all four nuts. Draw down tight. Test adjustment and if necessary remove or replace shims until adjustment is correct.



CAUTION

DO NOT HAMMER OFF ARM WITHOUT SUPPORT AGAINST END OF LEVER SHAFT

USE ARM PULLER IF POSSIBLE.

IF NECESSARY TO REMOVE ARM WITH HAMMER OR WEDGE. LIGHT BLOWS ARE MORE EFFECTIVE.

II. ADJUSTMENT FOR MINIMUM BACKLASH OF TAPERED STUDS IN CAM GROOVE

Adjust so that a very slight drag is felt through the mid-position when turning the steering wheel slowly from one extreme position to the other.

> Backlash of studs in the groove shows up as backlash at steering wheel and at ball on steering arm.
>
> The groove is purposely cut shallower, therefore narrower, in the mid-position range of travel of each stud (see illustration on next page) to provide close adjustment where usually the straight ahead driving action takes place. It also makes this close adjustment possible after normal wear occurs without causing a bind elsewhere.
>
> Therefore, adjust through the mid-position. Do not adjust in positions off mid-position as backlash at these points is normal and not objectionable.

To Adjust, tighten side cover adjusting screw (10) until adjustment is correct and tighten the lock nut (9) to hold it. Then give the gear a final test.

Secure the gear at all points loosened prior to making the adjustment. Also check tightness of mounting bracket bolts and nuts, and of steering arm on lever shaft and the nut and lockwasher (7). With all supporting brackets clamped tight, turn steering wheel to see if any stiffness exists. If so, the column is probably out of alignment and needs correcting. (Refer paragraph on "Column Alignment.")

ADJUST STUD-ROLLER BEARING UNITS

The foregoing adjustments will suffice in nearly every instance, but in some cases it may be necessary to adjust the stud-roller bearing units in the lever shaft.

When necessary to replace this type of stud roller bearing unit **replace both units.** Each set of two stud units is matched to assure proper pin contact in the cam lead. The roller bearings should be preloaded at all times. Adjust to a noticeable drag. Factory adjustments on new units are set to the minimum inch pounds of torque, as indicated below, to revolve stud. Used or replacement units should be set to this same minimum inch pounds torque; never below.

Unit	**Minimum Inch Pounds of Torque To Revolve Stud**
In 1⅜" and 1½" dia. shaft	3
In 1⅝" and 1¾" dia. shaft	4

To Adjust, (a) Wash bearings in kerosene and lubricate with light oil.

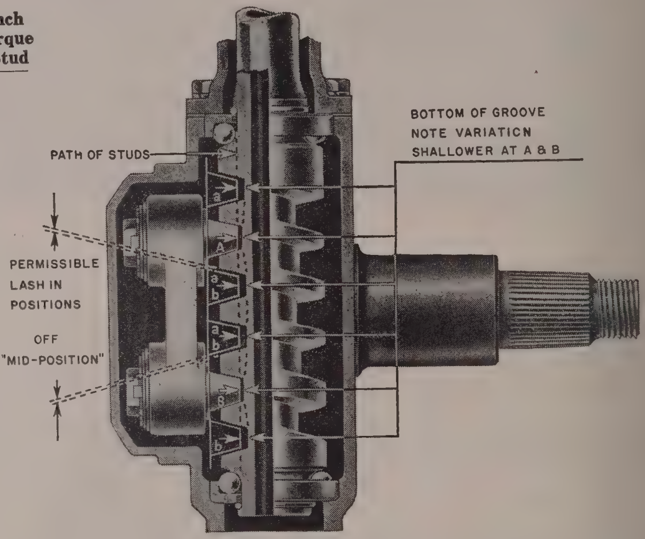
(b) Straighten out prong of locking washer and replace washer.

(c) Tighten nut as required (while holding stud from turning by using spanner wrench on washer, or by clamping stud **but do not nick or burr stud surface.**

(d) Turn stud back and forth and test adjustment.

(e) Lock adjustment by bending a prong of washer against a side of the nut. Bend the prong that is at right angle to side of the nut. **Do not use a washer twice** unless prongs used before have been removed.

(f) Lubricate with lubricant used in gear.



GEAR (Studs A & B) SHOWN AT MID-POSITION OF TRAVEL

a shows VARIOUS POSITIONS OF STUD A ON TURNS
b shows VARIOUS POSITIONS OF STUD B ON TURNS

IMPORTANT – ADJUST THRU THE MID-POSITION

LUBRICATION

Lubricate through the pipe plug hole or fitting in the top of the housing. Fill housing slowly until lubricant begins to run out of vent hole (8) in the jacket tube. Keep housing full by adding lubricant periodically according to usage—every few thousand miles or at least spring and fall. Use only a recommended or approved lubricant. (For list of approved lubricants see Bulletin 210A.)

GENERAL INFORMATION

COLUMN ALIGNMENT

Alignment of the column is of paramount importance. THE STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION FROM ITS FREE POSITION. To determine whether misalignment exists, release upper column bracket and note whether the column moves to a different position, its free position. If it does, it has been out of line and should be reclamped in the new position or the condition corrected by other methods provided by the vehicle manufacturer. **Caution:** If the column has been permanently bent because of severe misalignment, the above test may not be reliable, and replacement of the tubes will be necessary.

STEERING GEAR CONNECTION WITH FRONT WHEELS

Normally, the steering gear should be in approximately its mid-position when the front wheels are straight-ahead. To check, (the drag link must be disconnected from the steering gear arm) turn the steering wheel to the right as far as possible, then rotate the wheel in the opposite direction as far as possible and note the total number of turns. Turn wheel back just one-half of this total movement thus placing the gear in mid-position. Place front wheels straight ahead. The ball on the steering gear arm should now line up, or nearly so, with the ball socket of the drag link. If necessary, the steering arm can be shifted on the splines of the lever shaft to change the ball position. Shifting it one spline will shift the ball 10°. Some drag links can be adjusted in length to take up minor variations.

VENDOR: Fuller Manufacturing Co.	5-A-43-SP TRANSMISSION WITH REMOTE CONTROL

OPERATING INSTRUCTIONS

Always release the clutch completely before attempting to shift gears. Do not re-engage the clutch until the gears have been shifted completely into mesh. THIRD, FOURTH, AND FIFTH speeds are engaged by sliding clutches, requiring a relatively short shift. FIRST, SECOND AND REVERSE speeds are spur gears requiring a longer shift to complete the engagement. AVOID PARTIAL ENGAGEMENT and resulting damages.

LUBRICATION

OIL CAPACITY - 8 QUARTS

Use only high grade straight mineral gear oils of SAE 140 body for warm weather and of SAE 90 body for cold weather. Use Mobile grease No. 5 or its equivalent to lubricate the clutch release bearing.

FOREWORD

The RC Remote Control consists primarily of a gear selector mechanism which is mounted on the transmission shifting bar housing and which is activated by a shift lever and control rods. Its operation is identical with that of the conventional transmission control; the shift lever moving to the same positions. No special maintenance procedures are involved other than lubrication of the lateral shifting shaft and regular checks for worn parts.

DISASSEMBLY

A. Bottom Control Rod (Drag Link)

1. From each end of the rod, remove the cotter pins and turn out the slotted plugs until the rod is freed from the lower ends of both the long and short shift levers.

   NOTE: If the plugs are completely removed, do not lose the small spring and ball joint seats assembled into each of the rod ends.

B. Gear Shift Lever Housing Assembly

1. Turn out the capscrews or bolts by which the assembly is attached. Lift from the truck, both gear shift lever housing and the upper control rod which has also been freed. DO NOT LOSE THE FELT WASHERS.
2. Remove the grip at the upper end of the shift lever as well as the machine screw which retains the dust bell.
3. Mount the assembly in a vise with bottom opening of the housing upward.
4. Remove the shift lever tension spring by twisting a heavy screw driver between it and the housing. The spring will be forced from under the retaining lugs cast directly into the housing.
5. Withdraw the tension spring washer.
6. Withdraw shift lever through large opening in the housing by striking the

grip end on the floor to free the dust cover.

C. Upper Control Rod (Selector Shaft) - Removed During Operation "B"
1. Loosen the clamp screws in the selector yokes.
2. Tap the yokes toward the nearest end of the rod to clear them from the woodruff keys which prevent radial movement. Completely remove the yokes from the rod.
3. Remove woodruff keys from the rod.

D. Control Housing - Transmission Section
1. Remove capscrews and lift control housing from the transmission.
2. Remove clamp bolt from short shift lever installed on outer end of lateral shifting shaft.
3. Tap the short lever from the shaft.
4. Remove top cover from control housing.
5. Remove clamp bolt from inside short shift lever.
6. From the bottom of the extended housings, remove in the order named; small pipe plug, shifting shaft tension screw, and steel ball.
7. Withdraw shifting shaft. Pull sharply to free inside shift lever.

DISASSEMBLY INSTRUCTIONS

The following instructions are based on the assumption that the transmission has been removed from the chassis and that all supplementary equipment such as the universal joint companion flange and the brake assembly have been detached.

A. To Remove Gear Shift Lever and Housing Assembly
1. Shift the transmission into neutral position.
2. Remove capscrews by which the assembly is attached.
3. Lift the assembly from the transmission.

B. To Dismantle the Gear Shift Lever and Housing Assembly
1. At the top of the lever, remove the rubber grip and the rivets from the latch.
2. Force dust cover up and off the lever after removing the lock screw.
3. Remove tension spring and washer from inside the housing.
4. Withdraw shift lever assembly.
5. Remove clip assembled to lever directly under the pivot ball.
6. Move the reverse stop sleeve until the large hole coincides with the pin assembled into the lever.
7. Drive pin out of lever through large hole in sleeve.
8. Remove stop sleeve and latch rod.

C. To Remove Shifting Bar Housing Assembly
1. Remove capscrews by which the assembly is attached.
2. Lift the assembly from the transmission.

D. To Dismantle the Shifting Bar Housing Assembly
1. Shift into neutral position.
2. Remove locking wires and yoke screws.
3. Drive shifting bars from housing. Remove bars in order, top bar first.

VENDOR: Fuller Manufacturing Co.	5-A-43-SP TRANSMISSION WITH REMOTE CONTROL

DISASSEMBLY INSTRUCTIONS (Continued)

NOTE: ALL PARTS OF THE SHIFTING BAR HOUSING SHOULD BE LAID ON A CLEAN BENCH IN THE SAME SEQUENCE AS REMOVED. THIS PROCEDURE WILL NOT ONLY SIMPLIFY RE-ASSEMBLING THE YOKES, BARS, ETC., IN THEIR PROPER PLACES, BUT WILL ALSO REDUCE THE POSSIBILITY OF LOSING THE SMALL INTERLOCK PARTS ASSEMBLED INTO AND BETWEEN THE SHIFTING BARS.

E. To Remove The Mainshaft Assembly
1. Remove mainshaft and countershaft rear bearing covers.
2. Lock gears by shifting into two speeds and remove the countershaft rear bearing locknut exposed by the preceding operation.
3. Pull mainshaft and countershaft assemblies to the rear and remove mainshaft rear bearing.
4. Tilt mainshaft assembly and remove through top of case leaving sliding gears inside.
5. Remove loose gears from case.

F. To Dismantle the Mainshaft Assembly
1. Remove pilot bearing and sliding clutch using the latter part to start the bearing.
2. Remove washer retaining key from its keyway between the splines at the front end of the shaft.
3. Rotate the gear retaining washer in its groove until the lugs on its inside diameter line up with the grooves in the shaft.
4. Withdraw washer and upper bushed gear over pilot end of shaft.
5. Remove sleeve and lower bushed gear using the latter part to start the sleeve.

G. To Remove Clutch Shaft and Drive Gear
1. Loosen lock screws in the clutch release yoke and drive pedal shafts from yoke.
2. Remove yoke and shafts.
3. Detach pull-back spring and remove clutch release bearing and the carrier as a single unit.
4. Remove capscrews from drive gear bearing cover and withdraw clutch shaft and drive gear.

H. To Remove Reverse Gearing
1. Remove reverse idler shaft lock.
2. Withdraw reverse idler shaft.
3. Lift low reverse gear and bearings from case.

I. To Remove Countershaft Assembly
1. Pull countershaft assembly to rear and remove rear bearing.
2. Tilt assembly and remove through top of case.

J. To Dismantle Countershaft Assembly
  1. Remove gear retaining snap ring from front end of shaft.
  2. Press gears from shaft one at a time.

REASSEMBLY INSTRUCTIONS

With exception of a few specific points, the general instructions for assembly are merely a reversal of those for disassembly. The specific exceptions are as follows and should be given careful attention:

CLEARANCE - MAINSHAFT BUSHED GEAR

1. Replace worn washers to assist in maintaining original fit.
2. Hold end play of bushed gear to a minimum of .006 In. Check with indicator or feeler gauge.
3. Replace bushings in gears having excessive radial clearance.

ASSEMBLING BUSHED GEAR ON MAINSHAFT

When replacing either a new or re-bushed gear on shaft, be sure that it moves freely after having been assembled in its proper place. Clean all mounting parts and coat with oil before replacing gear.

ASSEMBLING SERVICE BUSHING IN MAINSHAFT GEAR

1. Remove old bushing.
2. Clean bore of gear carefully and remove all burrs.
3. Lubricate O. D. of bushing and press it fully into the gear.
4. Face off any projecting ends of bushing.
5. Drill oil holes in bushing through holes in the gear, making sure all holes are open.
6. Remove all burrs resulting from drilling and break all sharp edges of bushing.

ASSEMBLING MAINSHAFT SLIDING CLUTCH

One end of the sliding clutch is marked with the word "front". The clutch is assembled on the shaft with the marked end toward the engine.

UNIVERSAL JOINT COMPANION FLANGE

1. When assembling flange make sure no parts between it and the mainshaft rear bearing are omitted.
2. Pull flange tightly into place.

NOTE: THE MAINSHAFT IS HELD IN ITS PROPER PLACE BY THE COMPANION FLANGE, OMISSION OF PARTS BETWEEN FLANGE AND BEARING, OR FAILURE TO PULL THE FLANGE TIGHTLY INTO PLACE WILL ALLOW THE MAINSHAFT TO FLOAT ENDWISE WITH RESULTANT DAMAGE TO PILOT BEARING MAINSHAFT AND DRIVE GEAR.

SERVICE BULLETIN

VENDOR: Timken Detroit Axle Co.	Service and Maintenance for T-76 Transfer Case

The T-76 transfer case is one of the most popular units of its type incorporated in six wheel vehicles that have front driving axles. The transfer case is usually equipped with a declutch mechanism for engaging and disengaging the front driving axle and with a power take-off for driving auxiliary equipment such as a winch or air compressor.

REMOVE TRANSFER CASE FROM VEHICLE

A. Remove drain plug at bottom of transfer case to drain lubricant.
B. Disconnect case control linkage.
C. Disassemble propeller shaft universal joints and drop propeller shafts.
D. Block up transfer case on roller jack or hold securely with sling and Chain fall.
E. Remove transfer case mounting stud nuts or cap screws.
F. Lower transfer case on roller jack or with chain fall to skid. Remove from under vehicle.
G. Remove all cotter pins and nuts on compaion flanges and universal yokes. Remove flanges on power take-off, rear output and input shafts.

(Engage declutch mechainsm and remove all yoke and flange nuts with suitable wrenches or by holding front universal yoke with for, loosening other nuts with wrenches. Hold parking brake flange with bar held to flange by two bolts).

DISASSEMBLY OF TRANSFER CASE

A. Remove declutch and power take-off assemblies by removing stud nuts and lock washers. Tap or lift off assemblies. (Shims which are between the main case cover and power take-off case should not be lost as they control the main shaft bearing adjustment.)
B. Remove front bearing covers. Speedometer driven gear and sleeve will be taken off with idler shaft front cover. Main shaft front cover can be removed using the puller screws.
C. Remove shifter shaft fork by taking out 4 cap screws and lock washers, cover breather plate and gasket at shift opening. Remove plunger spring, plunger and ball. (A magnet may be used for removing plunger and ball or the case may be turned on its side so that they will fall out.) Remove cotter pin, lock washer, nut and bolt and clamping fork from shifter shaft. Unscrew shift shaft out of fork, turning counter clockwise. Remove shaft and shifter fork.
D. To remove power take-off driving clutch loosen screw holding clutch jaws on main shaft, pry off clutch section with screw driver.
E. Remove declutch shaft driving clutch by loosening lock screw inside of clutch. Pry off clutch with screwdriver.
F. Remove cover from case by driving out 4 cover and case dowels. Remove all case to cover stud nuts, lock washers and cap screws. Position case so it

it will rest on cover. Block it in this position to prevent it from resting on end of output shaft or trunnion support. Tap on center shaft and lift case straight up off cover and gear train.

G. With two pry bars, disassemble gear train by lifting idler shaft sufficient- in cover so that other two shafts can be lifted and tilted out of engaged position in herringbone gears and out of roller bearing cups in covers. This transfer case assembly is now broken down into its component sub-assembly.

INSPECTION

A. All transfer case parts should be thoroughly cleaned with solvent. Use a stiff brush and scrub thoroughly to remove all traces of old lubricant and accumulated dirt.

B. Examine the case carefully for cracks and dents. Tap the case with hammer at various points, check for cracks which otherwise might not be evident.

C. Inspect all bearings. Immerse all three shaft and gear sub-assemblies in clean solvent and with a soft brush clean thoroughly. Move sliding gear towards front of drive shaft so that main herringbone gear may be slid off O.D. of ball bearings on which it rotates. Rotate ball bearings while under solvent to clean thoroughly and to detect roughness and out of round condition. Also check for looseness. After ball bearings are clean, put a few drops of motor oil in the races and again rotate by hand, checking for wear.

D. Wash all bearings in suitable solvent, dry with soft cloth and dip in light engine oil. The condition of the bearings determine principally the condition of the bearing surfaces. Make a careful visual inspection of the bearings checking particularly for wear or out of round condition of rollers and balls. If rollers or balls are worn, ridged, out of round or cracked, the bearing should be replaced. When the inspection is complete and if the bearing is suitable for further service it should be dipped in clean gear lubricant and placed in a clean covered container or wrapped in wax paper until needed in reassembly.

E. Examine the teeth of all gears for nicks, chipping, scoring, and galling. Gears which are nicked or chipped should be replaced. Slight burrs or scores may be removed with an oil stone.

F. Inspect the shaft flange and sliding gear for twisting and scoring. Place sliding gear on shaft and check clearance along flange. If the clearance is excessive, so that the gear can be twisted on the shaft or if the shaft is scored or twisted, new parts should be installed.

G. Examine the oil seals prior to removal. Do not reinstall removed oil seals. Inspect the seal for general conditions and deterioration of sealing elements. If it is not worn it may be left in place and used again. However, do not take chances with oil seals that appear to be only slightly worn. Replacement of oil seals while the unit is disassembled is much more economical than premature service to replace these items later. It may also help prevent future failure of gears and bearings due to a lack of lubricant.

H. It is usually advisable to replace all gaskets when assembling the transfer case. In some cases, if the gasket is not torn, cut or badly compressed, it may be used again. However, future gasket failure may be avoided if new gaskets are installed.

SERVICE AND MAINTENANCE PROCEDURE FOR T-76 TRANSFER CASE Cont'd

I. The transfer shifter shaft fork cover bearing plate and breather eliminates the possibility of internal pressure. Inspect breather to be sure it is open and operating. Clean it thoroughly with solvent, removing all lubricant and dirt accumulation. Dry slowly with compressed air.

J. Examine the driven shaft and main shaft gear bushings for scoring, galling and burrs or rough spots. Replace worn bushing using arbor press.

SERVICING TRANSFER CASE SUB-ASSEMBLIES

A. Press driven shaft forward bearing cup from transfer case.

B. Press main drive shaft rear bearing cup and oil level baffle plate from transfer case cover.

C. Disassemble Main Drive Shaft Assembly

1. Press main drive shaft forward bearing cone off shaft using arbor press.
2. Lift off main drive shaft sliding gear and slide off main shaft herringbone gear.
3. With arbor press, press off two main drive shafts, gear ball bearings and bearing spacer, main drive shaft gear rear bearing spacer and tapered roller bearing cone. All of these parts will be removed in one pressing operation.

D. Dissassemble Driven Shaft Assembly

1. Place driven shaft assembly in arbor press resting on herringbone gear and press driven shaft out of driven gear and rear bearing cone in one operation.
2. Reverse position of driven shaft and arbor press and press off driven shaft forward bearing cone.

E. Dissemble Idler Shaft Assembly

1. Remove speedometer retainer washer, drive gear, and spacer washer at front of idler shaft. Remove retainer washer at rear shaft by cutting lock wire and taking out cap screws.
2. Place idler shaft assembly in arbor press with idler shaft forward and idler shaft low speed gear upward. The low speed gear should rest on arbor press support plate. Press off forward bearing spacer and low speed gear. Remove idler shaft from arbor press and lift off idler shaft low speed gear spacer.
3. Reverse position of the assembly and arbor press, press of idler shaft rear bearing, rear bearing spacer and idler shaft herringbone gear.

F. Disassemble main drive shaft forward bearing cage by clamping it in a vise. Using a soft drift and hammer, drive out in successive operations, the main drive shaft forward bearing cage oil seal. Drive from front of cage to remove the cup, from rear of cage to remove the oil seal. (Remove oil seal only if inspection indicates replacement is necessary.)

G. Clamp driven shaft rear bearing cage in vise. Using a soft drift and hammer drive out in successive operations, driven shaft rear bearing cup and driven shaft rear bearing cage oil seal. Drive from front of cage to remove cup and from rear of cage to remove oil seal.

ASSEMBLY OF TRANSFER CASE

A. Using soft drift and hammer, drive the driven shaft forward bearing cup to seat firmly in the transfer case.

B. Using soft drift and hammer, drive main drive shaft rear bearing cup to seat firmly in transfer case cover.

C. Assemble Main Drive Shaft

  1. Using an arbor press, press main drive shaft forward bearing cone on splined end of main drive shaft. Then slide main drive shaft sliding gear on shaft.
  2. Install forward main drive shaft ball bearing pressing bearing pressing bearing to seat against shoulder of shaft.
  3. Slide main drive shaft gear bearing spacer on shaft and then press rear main drive shaft bearing on shaft.
  4. Position main drive shaft gear on shaft. Using soft hammer, tap it to seat on two previously assembled ball bearings.
  5. Position main drive shaft rear bearing spacer on shaft. Using arbor press, install main drive shaft rear bearing cone.

D. Assemble Idler Shaft

  1. Press idler shaft into low speed gear.
  2. Slide idler shaft forward bearing spacer on shaft. Press idler shaft forward bearing on shaft in arbor press and position speedometer drive gear spacer in place.
  3. Position speedometer drive gear key in keyway in idler gear shaft. Tap speedometer drive gear on shaft with soft hammer.
  4. Place idler shaft forward bearing retainer washer on end of shaft and fasten securely with two capscrews. Lock cap screws with soft iron wire.
  5. Reverse the position of assembly in arbor press, slide idler shaft low speed gear spacer on shaft. Press idler shaft idler gear on shaft.
  6. With assembly in same position, slide idler shaft rear bearing spacer on shaft and press idler shaft rear bearing against spacer.
  7. Place idler shaft rear bearing retainer washer on shaft and install t two retainer washer cap screws. Lock the cap screws with soft iron wire.

E. Assemble Driven Shaft

  1. Press driven gear on driven gear shaft in arbor press.
  2. Press driven shaft rear bearing cone into position.
  3. Reverse position of the assembly in the arbor press and press driven shaft forward bearing cone on shaft.

F. Assembling Gears and Shafts

  1. Assemble rear driven shaft bearing cage in transfer case with new

gasket and original shims. Tighten in place with three stud nuts.

2. Place transfer case cover horizontally, and support in same manner as when case was disassembled. With low speed end of idler shaft up, start bearing into center bore but do not allow it to go all the way.
3. Now mesh main drive gear of drive shaft and driven gear of driven shaft into gear on idler shaft and into their respective cups.
4. Tap end of idler shaft with soft hammer, driving idler shaft into place and lining up herringbone gears. The gear train assembly should line up in the cover as shown in the accompanying figure.

G. Assemble Transfer Case and Cover

1. Tap 4 transfer case and cover dowels lightly into position and place new gasket on transfer cover. Position transfer cover over the inverted shaft and on to the idler shaft bearing. Tap the case lightly with soft hammer to correctly position it.
2. Install transfer case to cover bolts, lock washers and nuts using an open end wrench to hold bolts and a socket wrench to turn the nuts. Tighten nuts to proper torque.
3. Install 4 transfer case to cover tapered dowels and drive in place with hammer. The recommended service maintenance procedure for the power take-off and declutch assemblies are covered at the end of the case assembly procedure.

H. Install Power Take-Off Case

1. Place a new power take-off case gasket over stud. Position power take-off cage shims over stud. Be sure oil groove hole in gasket and shims are properly aligned.
2. Install oil level baffle plate.
3. Position power take-off driving clutch on shaft and line up set screw hole with indentation in shaft. Tighten set screw securely in driving clutch.
4. Position power take-off case over studs and install lock washers and nuts.

I. Install Declutch Shaft

1. Install declutch shaft driving clutch on shaft, lining up screw with shaft indentation. Tighten set screw securely.
2. Place a new declutch shaft carrier gasket over carrier studs. Position the declutch shaft carrier on the studs and install lock washers and nuts.
3. Test the action of the declutch shaft carrier by moving the clutch shift lever all the way back and then forward. The sliding clutch must fully dis-engage so that the driven shaft will not turn when the declutch shaft is turned by hand. The sliding clutch jaws must engage and turn the driven shaft when the shift lever is moved in the opposite direction.

J. Assemble and Install Main Drive Shaft Forward Bearing Cage

1. Use a soft drift and hammer to drive the main drive shaft bearing cup into position in the main drive shaft forward bearing cage.
2. Install new oil seal in cage, using suitable driver.
3. Install new gasket on cage studs. Place cage on studs and install lockwashers and nuts.

K. Before installing driven shaft rear bearing cover, place new gaskets over cage studs. Replace cage shims which were removed from this location when the unit was dis-assembled. Install cage on studs and secure with lockwashers and nuts.

L. Assemble the idler shaft rear bearing cover gasket and cover. Install lockwashers and cap screws. The idler shaft and gear assembly floats in the transfer case and the herringbone gear on the drive shaft floats on the O.D. of the two ball bearings. Note that the driven shaft herringbone gear is the only one which is not free. The apexes of the herringbone teeth in these gears must mesh together and it is practical to hold one gear in position, allowing the other gears to float into proper alignment. For this reason the idler shaft ball bearings are not a press fit in their respective bores, but are allowed some limited movement.

Adjustment of Drive and Driven Shaft Bearings

Adjustment of these bearings as controlled by shims render the power take-off cage on the drive shaft and by shims under the driven shaft rear cover and oil seal assembly. The thickness of these shims is .003", .005", .010" and .020". By using different combinations on these shims, steps of .001" may be obtained in most shim packs.

The correct bearing adjustment for both of these shafts is .003" to .005" and play.

To obtain the proper drive shaft bearing adjustment, install the original shim pack when the power take-off cage is installed, then check with an indicator. Mount the dial indicator on front of transfer case and place plunger on end of drive shaft. Push the shaft in as far as possible. Set indicator needle to zero, then pull shaft out. The indicator reading should be .003" minimum to .005" maximum end play. Remember, shims under power take-off cage control drive shaft bearing adjustment.

Proper bearing adjustment for the driven shaft is identical to that of the drive shaft, except the indicator should be mounted on the rear of the transfer case with plunger on rear end of driven shaft. Driven shaft bearing adjustment is controlled by shims under the driven shaft rear cover and oil seal assembly.

M. Assemble Transfer Case Shifter Fork

1. Install shift shaft fork bolt in shaft fork. Install lockwasher and turn bolt nut about 8 complete turns by hand.
2. Place fork assembly in transfer case through breather cover opening with jaws of fork fitting into the deep groove around main drive shaft sliding gear. The fork boss should face toward the shift shaft opening.

N. Install Transfer Shift Shaft

1. Place shaft packing in transfer case and tap it down with soft hammer.

SERVICE AND MAINTENANCE PROCEDURE FOR T-76 TRANSFER CASE Cont'd

Place packing retainer over packing and tap it flush with transfer case.

2. Screw shift shaft through shift fork. (The indentation in the shift shaft should be seen directly beneath the shaft fork lock ball opening in the transfer case.
3. Before tightening the fork and shaft, check fork for proper location. Move fork and sliding gear to low range position and install the ball, plunger, and spring in detent hole. Depress the spring by hang to locate ball and shaft groove. Check location on sliding gear. Now screw shaft in or out of fork to get full gear engagement. When adjustment is correct, tighten shift fork nut.

O. Install Shaft Fork Cover

1. Install shift shaft fork lock ball, lock ball plunger and lock ball spring, in order name into transfer case.
2. Place transfer case shaft fork cover gasket, breather plate and cover in position and install lockwashers and capscrews.

P. Install Idler Shaft Forward Bearing Cover

Place idler shaft forward bearing cover gasket and cover in position and install lockwashers and four short, two long capscrews.

Q. Install Speedometer Driven Gear

1. Position gear in idler shaft forward bearing cover with lower end of gear in its recess in the cover. Lubricate gear with oil.
2. Install speedometer driven gear sleeve.

R. Install Parking Brake Flange

1. Drive parking brake flange on driven shaft using a suitable driving sleeve.
2. Install driven shaft nut, tightening it proper torque and lock with cotter pin.

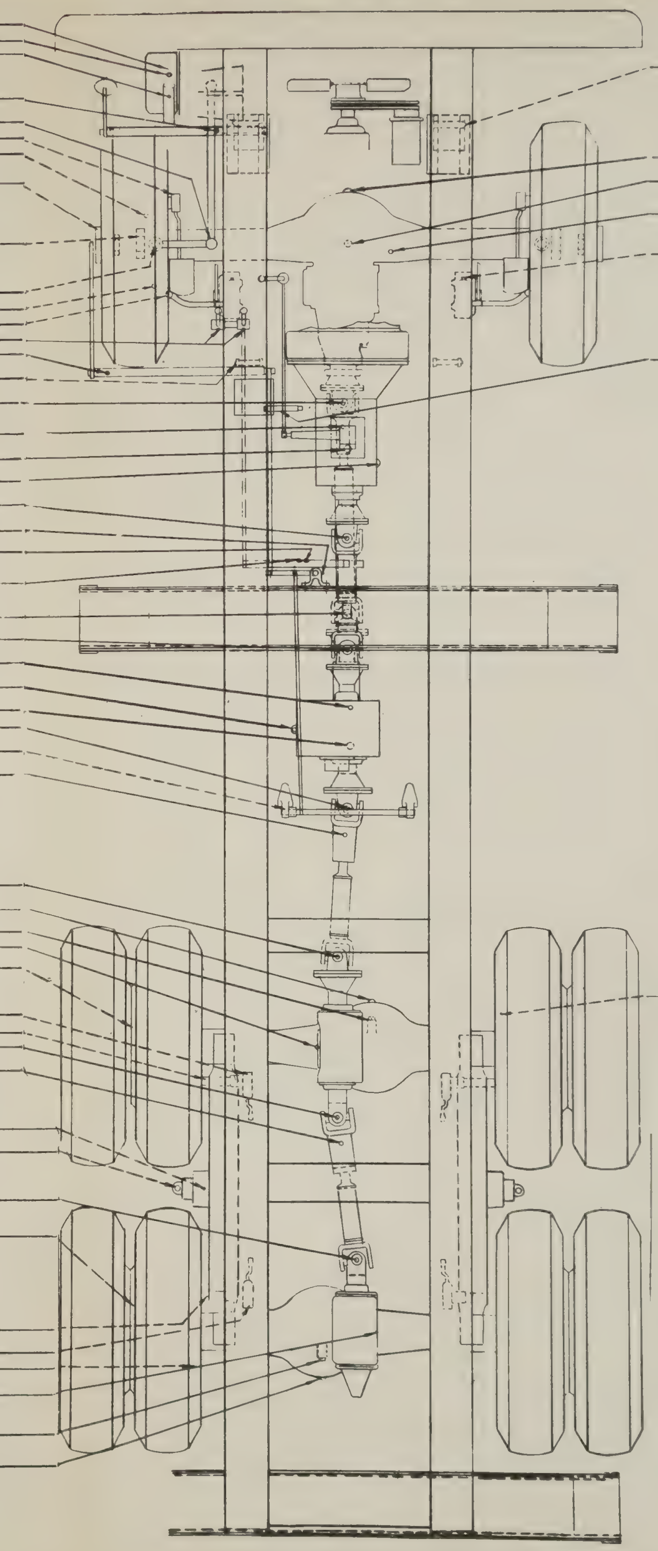
S. Install Transfer Case Companion Flange

1. Drive transfer case companion flange on main drive shaft using a suitable driving sleeve.
2. Install and tighten main drive shaft nut. Lock with cotter pin.

SERVICE BULLETIN

VENDOR: Hendrickson Motor Truck Company	Chassis Lubricant Chart

SEE INSIDE



LUBRICANT - INTERVAL		
Steering Gear Housing Drain	GL	M
Steering Gear Housing Fill	GL	M
Steering Gear Housing Vent (Fill housing until lubricant extrudes from vent		
Clutch Pedal Cross Shaft	GG	W
Drag Link	GG	M
Slack Adjusters	GG	M
Steering Drive Level (Remove plug, maintain level)		M
Steering Drive Joint Fill (Remove drive flange plug, install temporary fitting, and lubricate until lubricant is observed at level plug)	GL	M
Front Wheel Bearings (Remove wheels, and inspect all parts. Replace damaged or worn parts. Repack bearings and reassemble)	BG	S
King Pin Bearing	GG	M
Brake Pivot	GG	M
Tie Rod	GG	M
Transfer Case Shift Levers	GG	W
Emergency Brake Lever Cross Shaft Bearing	GG	W
Spring Shackles (Two fittings each side)	GG	M
Front Axle Propel Shaft Universal Bearing	GL	M
Front Axle Propel Shaft Spline	GG	M
Main Transmission Case Drain		S
Main Transmission Case Fill and Level	GL	M
Propel Shaft Universal Bearing	GL	M
Emergency Brake Crosslever Mounting Brackets	GG	M
Transfer Case Shift Lever Cross Shaft (Front Axle engaging)	GG	W
Transfer Case Shift Lever Cross Shaft (Hi-low ratio)	GG	W
Front Axle Propel Shaft Universal Bearing	GL	M
Propel Shaft Universal Bearing	GL	M
Transfer Case Breather (Clean and reoil)	EO	M
Transfer Case Fill and Level	GL	M
Transfer Case Drain		S
Propel Shaft Universal Bearing	GL	M
Emergency Brake Cross Shaft	GG	M
Propel Shaft Spline	GG	M
Propel Shaft Universal Bearing	GL	M
Front Rear Axle Differential Fill and Level	GL	M
Front Rear Axle Drain		S
Front Rear Axle Breather (Clean and reoil)	EO	M
Front Rear Wheel Bearings (Remove wheels, and inspect all parts. Replace damaged or worn parts. Repack bearings and reassemble)	BG	S
Slack Adjuster	GG	M
Brake Shoe Cam Shaft	GG	M
Propel Shaft Universal Bearing	GL	M
Propel Shaft Spline	GG	M
Rear Axle Beam Bushing	GG	M
Rear Axle Beam Center Tube	GL	M
Propel Shaft Universal Bearing	GL	M
Rear Wheel Bearings (Remove wheels, and inspect all parts. Replace damaged or worn parts. Repack bearings and reassemble)	BG	S
Brake Shoe Cam Shaft	GG	M
Slack Adjuster	GG	M
Brake Shoe Anchor Pin	GG	M
Rear Axle Differential Breather (Clean and reoil)	EO	M
Rear Axle Differential Drain		S
Rear Axle Differential Fill and Level	GL	M

INTERNAL - LUBRICANT		
M	GG	Front Spring Hanger Belt
M	GL	Front Axle Differential Fill and Level
S		Front Axle Differential Drain
M	EO	Front Axle Breather (Clean and reoil)
M	SF	Front Axle Shock Absorber Fill and Level
W	GG	Clutch Control Rod Cross Shaft
M	GG	Brake Shoe Anchor Pin

Note:

Intervals given are for normal 8-hour day operation.

For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating.

Relubricate after washing or fording.

Clean parts with SOLVENT, dry-cleaning, or with OIL, fuel, Diesel.

Dry before lubricating.

Lubricate points indicated by dotted arrow shafts on both sides of equipment.

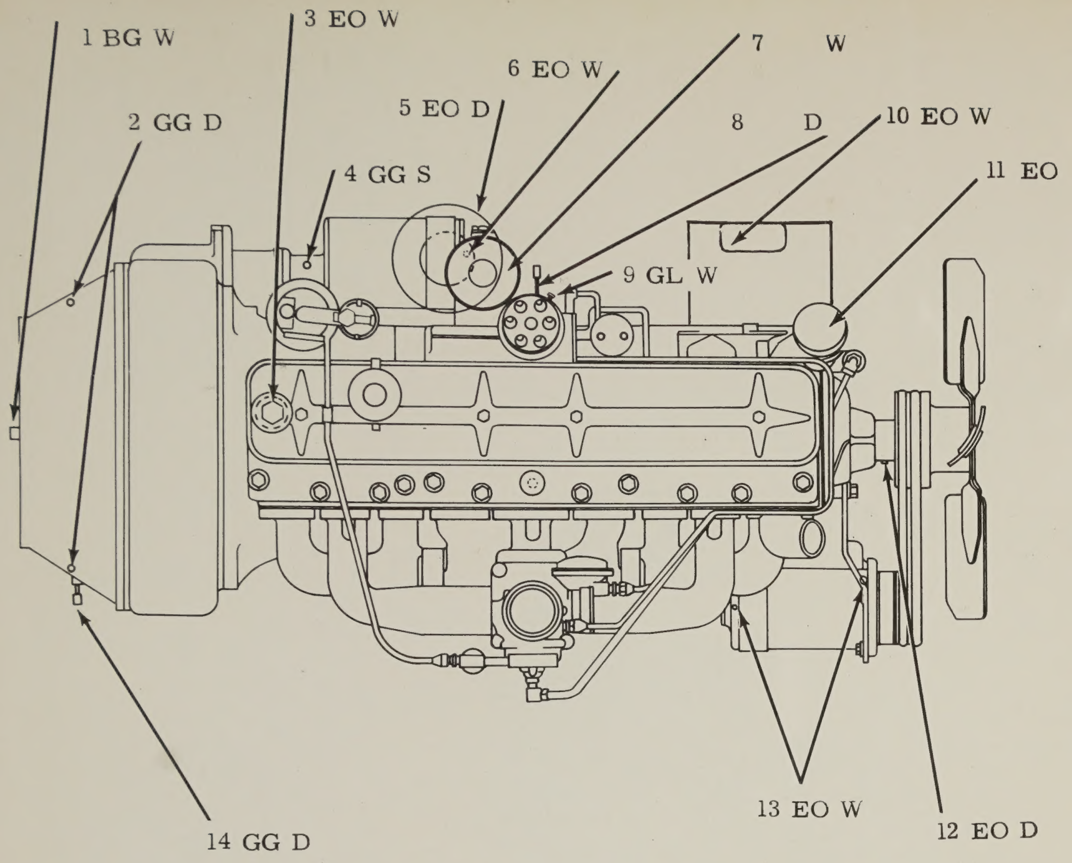
Drain crank and gear cases only when hot after operation; check level and replenish when cool.

LUBRICANT	CAPACITY	EXPECTED TEMPERATURE		INTERVAL
EO - Oil, Engine		Above 32 deg. fahr.	Below 32 deg. fahr.	D - Daily W - Weekly M - Monthly S - Semiannually
GL - Gear Lubricant, Universal		SAE-140	SAE-90	
Main Transmission Case	8 Quarts			
Transfer Case	2 Quarts			
Front Axle	10 Quarts			
Rear Axle Differentials (Each Axle)	10 Quarts Each	SAE-140-E.P.	SAE-90-E.P.	
GG - Grease, General Purpose		Mobile Grease #3 or equal		
BG - Grease, General Purpose		Marfax #2 or equal		
SF - Shock Absorber Fluid		Delco shock fluid or equal		

SERVICE BULLETIN

VENDOR: International Harvester Company	CE - 5530 ENGINE LUBRICATION DIAGRAM FOR; I.H.C. RD-406 Engine

SEE INSIDE



ENGINE LUBRICATION DIAGRAM FOR; I.H.C. RD-406 Engine

Note:
OIL CAN POINTS - Every week lubricate, Transmission Shifter Red Joint Assemblies, Interconnecting DeClutch, Gear Shift, and Brake, Rods, Pins, Clevises, and Threads, Exposed Springs, Throttle, Carburetor, Governor Corrections, Adjusting Screws and Outrigger Screws with EO.

A *Add 1 Quart when changing oil filter element

LUBRICANT	CAPACITY	EXPECTED TEMPERATURE			INTERVAL
EO- Oil, Engine		+32°F	+32°F to 10°F	16°F to-10°F	D-Daily W-Weekly M-Monthly S-Semi-annually
Engine Crankcase*	9 Quarts	SAE-40	SAE-20W	SAE-10W	
Air Cleaner	2 Quarts	SAE-40	SAE-20W	SAE-10W	
GL- Gear Lubricant, Universal		SAE-140	SAE-90		
G- Grease, General Purpose		Mobile Grease #3 or equal			
BG- Grease, General Purpose		Marfax #2 or equal			

1. Clutch Pilot Bearing (Sparingly)
2. Clutch Release Shaft
3. Crankcase Drain Plug (Drain and refill)
4. **Starting** Motor Gear Case (Remove plug, fill case 3/4 full)
5. Air Cleaner (Clean and refill oil reservior to level mark) (Every week disassemble entire unit, clean and reassemble)
6. Starting Motor (Sparingly))When equipped with sealed type bearings, no lubrication required)
7. Oil Filter (Clean and renew element)
8. Crankcase Level Cage (Check level)
9. Distributor Shaft (Turn cup down one full turn, refill as necessary)
10. Compressor Air Strainer (Clean and reoil)
11. Crankcase Fill Plug
12. Fan and Water Pump Bearing (Replace Plug)
13. Generator (Sparingly) (When equipped with sealed type bearings no lubrication required)
14. Clutch Throw-cut Bearing (Sparingly)

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